



A Report on the Work done by
the Research Staff under the
Locust Research Entomologist to
the Imperial Council of Agricultural
Research at Karachi during the
year 1936

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BY

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An account of the progress made during the current year is submitted in the present report, which is being presented in four different parts. Part I will deal with the General Report on the results of survey work and ecological studies. The results of the experimental work carried out at Pasni, Ambagh and in parts of the Desert areas will be dealt with in Part II, while studies of locust movements in the past as correlated with meteorological data, as well as various miscellaneous items, and the present year's conclusions will be included in Part III. Part IV will be devoted to suggestions for future work.

PART I.

GENERAL REPORT.

I.—PERSONNEL.

I was in charge of the Locust Research Scheme with headquarters at Karachi throughout the year.

Staff at Karachi.—Dr. S. Mukherji, D.S. (Cal.), was appointed as Assistant Entomologist at headquarters from the 10th January 1936, and attended to the experimental work and collections at Karachi and was in charge of the office during my absence from headquarters. Mr. Rashid Ahmad, B.Sc. (Hons.), worked as Biometrical Assistant at Karachi till the 16th May, when he was posted to Pasni to officiate as Mekran Survey Assistant. Mr. Ram Lal Gupta, M.Sc., was appointed as Biometrical Assistant from the 10th October. Mr. Chandar Parkash, B.Com., Senior Compiling Assistant, left the Locust Scheme on the 3rd October to take up an appointment in the Imperial Institute of Sugar Technology, Cawnpore, and his place was filled up by Mr. V. Ramani. Mr. H. G. Sheikh, Second Compiling Assistant, was promoted as Accountant in the place of Mr. R. L. Mehta transferred to Cawnpore in October and Mr. A. Lateef Sabir was appointed in the vacancy.

Staff in Southern Baluchistan.—Dr. M. L. Roonwal, M.Sc., Ph.D. (Cantab.), continued to work as Assistant Locust Research Entomologist at the Pasni Locust Research Station in charge of the work in the Mekran area, and Mr. S. M. Taqi Ahsan, M.Sc., as Locust Research Assistant at Pasni. Mr. Rahmatullah Butt, M.Sc., was appointed as Mekran Survey Assistant with headquarters at Pasni at the end of December 1935 and attended to the supervision of locust survey work in Mekran till the 7th May 1936, when he left

Pasni on leave and could not return for reasons of ill-health. Mr. Rashid Ahmad, Biometrical Assistant, officiated in his place and was ultimately confirmed as Survey Assistant at Pasni. Mr. R. N. Batra, M.Sc., continued to be in charge of the Ambagh Field Research Station. A new outpost in charge of a Fieldman was opened in July at Panjgur in Mekran for locust survey work.

Staff in the Sind-Rajputana Area.—Mr. Des Raj Bhatia, M.Sc., was stationed at Barmer in charge of the three Locust Outposts at Chachro, Nokh and Sardarshahr and of the locust survey work in the Desert area. The Outpost at Mahwar near Barmer was abolished from April 1st, 1936, as recommended by the Locust Committee.

II.—ITEMS OF LOCUST RESEARCH WORK IN PROGRESS DURING THE YEAR.

1. *Ecological Study of the Solitary Phase Locust in its natural Habitats.*—

Work was carried out in the following centres:—

- A. *Pasni* : representing the winter-rain areas of the Mekran coast.
- B. *Ambagh* : as typical of the summer-rain areas of that coast.
- C. *Chachro* : representing the southern areas of the Indian Desert, viz, Thar-Parkar and Mallani.
- D. *Nokh* : as a centre for the northern area of the Desert,
- E. *Sardarshahr* : for the north-eastern or Bikaner areas.

2. *Distributional Survey of the Habitats of the Locust.*—

- A. *Mekran Circle.*—Surveys on the Coastal reks, and in the hinterland of Mekran, including Kech, Kolwa, Kulanch, Dasht and Panjgur, with Pasni, Gwadar, Turbat and Panjgur as centres.
- B. *Lasbela Circle.*—Surveys on the Coastal reks and in the hinterland of Lasbela, with Ambagh as centre.
- C. *Bikaner Circle.*—Surveys in the Bikaner desert areas with Sardarshahr as centre.
- D. *Jaisalmer Circle.*—Surveys in the northern and eastern parts of the Jaisalmer area and in parts of north Marwar, with Nokh as centre.
- E. *Thar-Mallani Circle.*—Surveys in the desert areas of Thar-Parkar District of Sind, and of south Marwar, with Chachro as centre.
- F. *Khairpur Circle.*—(For part of the year) for surveys in the Khairpur-Bahawalpore areas during the summer months.

3. *Study of the Movements of Locusts—either as swarms or individuals during the year.*

4. *Study of Old Records.*—Compilation and mapping of Locust Data.

5. *Study and Correlation of Meteorological Data* in connection with recorded locust data.

6. *Study of the Fauna and Flora collected during Survey Work.*

7. *Biometrical Study of the Locust Collections.*

III.—SURVEY WORK.

Tours.—In carrying out locust survey work, the plan adopted in 1935 was in general followed, intensive surveys around the various centres as well as long distance surveys on a 50—100 miles' radius around them being carried out throughout the year. In addition, certain special visits were also arranged, such as tours in the West Sind, Kachhi and Dera Ghazikhan areas, surveys in the Khairpur-Bahawalpore areas by a Fieldman stationed at Khairpur during June—October, and tours across the desert from Khairpur into Jaisalmer and Marwar, and from Jaisalmer into Bahawalpore. In the Mekran area, owing to the enormous stretches of area to be covered by the Turbat Fieldman, it was found impossible to arrange to have a fairly frequent inspection of the hinterland of Mekran in order that the development of 'outbreak centres' in that area might be detected in time. With the sanction of the Imperial Council of Agricultural Research, a new Outpost was opened at Panjgur in charge of a Fieldman in July, who was instructed to make fairly frequent surveys of the Gar-Sehbazan, Dasht-Shahbaz and Kolwa areas, while the Turbat Fieldman was to restrict himself to the Kech, Buleda and Parom areas.

As instructed by the Locust Committee, a standard form of reports to be submitted by Fieldmen engaged in Locust Survey work was drawn up and submitted for approval.

In computing the density of locust populations, the rough formula worked out last year was followed. It was felt, however, in the course of the work that there was no necessity to have a different rate of computation for surveys undertaken in winter as compared with those of summer, since survey work was attended to at the hottest part of the day in winter, when locusts were fairly active. Again, experience this year at Pasni has shown that surveys on camel-back have on most occasions given very unreliable results, as compared with foot-surveys made in parts of the area examined. Surveys on camel-back would appear to be useful only when the locust population is fairly dense and the locusts happen to be active and excitable, as they were during the period of the Locust incursion of July-August 1935.

Statements A-I, A-II, and A-III contain particulars of all tours actually carried out in the Sind-Rajputana, Mekran and Lasbela Circles, each tour being given a serial number for purposes of reference.

Results of Locust Surveys.—The results obtained in regard to locust finding this year have been classified under :—

I. *Results of extensive surveys.*—Which have been given in Statements B-I, B-II and B-III for Sind-Rajputana, Mekran and Lasbela Circles respectively, and II. *Results of intensive surveys.*—Shown in Statements C-I for Pasni, C-II for Gwadar, C-III for Ambagh, C-IV for Chachro, C-V for Nokh and C-VI for Sardarshahr. As in 1935, the results have been arranged according to the different seasons, and, as far as possible, the approximate population density has also been indicated.

Weather in the regions of habitat of the Desert Locust in N. W. India in 1936.

A review of the seasonal rainfall in 1936 is briefly made below, as it is essential for interpreting the locust developments of the year.

Winter Rainfall.—The first western disturbance of 1935-36 winter season made its appearance on the 8th October 1935 in the winter-rainfall areas of Baluchistan, Iran and N. W. India, and the last one during the last week of May 1936. Altogether about 57 different western disturbances were recorded during the season of 1935-36.

During December, there was very little rainfall anywhere except in the Bushire area, which recorded a total of 8 inches. In January, there was fairly good rainfall during the earlier half of the month, the principal falls being Muscat 5.60", Sharjah 2.10", Bushire 3", Gwadar 0.50", Pasni 2", Ormara 1.80", Jask 1.90", Bahrain 0.60" and Quetta 1.70". The latter half of January and the first fortnight of February proved to be a dry period. During the last ten days of February, a fall of 2.50" was recorded at Ormara and 0.80" at Pasni, owing to the development of two depressions along the coast. During the early half of March, Gwadar received a fall of 2.50", Pasni 0.90", Ormara 0.90" and Turbat 1.15". There was little rainfall subsequent to this period anywhere except at Panjgur (0.53" on the 19th May), Kalat and Quetta about middle of May.

In the Indian Desert area, the influence of the western disturbances was but little felt during 1936, except in February when a few good falls occurred in the Jaisalmer-Bikaner area.

The winter rainfall in the Mekran coastal area amounted in all to about 4 to 5 inches during the year, which is much below the normal (about 7 inches at Pasni).

Summer Rainfall.—The South-West Monsoon set in very early this year both in the Arabian Sea and the Bay areas by about the 19th May, causing rainfall on the West Coast and the formation of a cyclone at the head of the Bay. This was followed by another depression which appeared early in June, in the Bay of Bengal, and though both brought very heavy rainfall into the eastern parts of India, they did not extend their influence into N. W. India, except in parts of east Rajputana. Widespread thunder shower rain occurred between the 20th and 26th June in Rajputana, Punjab and South Sind, *e.g.* Bikaner and Jodhpur 2 inches each. A depression which appeared in the last week of June, however, passed across the Rajputana desert area and caused general rainfall at the end of June and during the first week of July, Badin recording about 10", Karachi 3", Bikaner about 4", Jodhpur about 4", Barmer 2", Khanpur 1½", Bahawalpur 2", Multan 1½", Chachro 3.80", Mithi 3" and Bela 1". The influence of this depression extended also into Lasbela and Mekran. Towards the middle of July, there was some rainfall in Bahawalpore and Upper Sind, but on the whole the latter part of July was dry, and the drought that set in continued upto the 10th August in the Rajputana area. A depression that passed over north Rajputana between the 12th and the 16th gave very heavy rainfall in parts of Bikaner and Jaisalmer, Nokh recording 16", Bikaner 10", Srikolaytji 15", Surpura 13", Ratangarh 8" and Mahajan 4", but in other parts of the desert the rainfall was light. Between the 19th and

the 23rd August, there was widespread rainfall in west Rajputana areas, Barmer recording $1\frac{1}{2}$ ", Jodhpur $1\frac{1}{2}$ " and Bikaner 2". During the early half of September, fairly widespread rainfall occurred between the 8th and the 13th in south Rajputana, Southwest Punjab, south Sind and eastern Baluchistan, under the influence of a depression moving north-westwards over the Central Provinces. Multan recorded 4", Bahawalpore $1\frac{1}{2}$ ", Khanpur 1", Badin 3", Chhor 2", Chachro $1\cdot25$ ", Barmer and Jodhpur $1\frac{1}{2}$ ". Widespread thunderstorms occurred on the 16th and the 17th September in Baluchistan, Lasbela 2", Sibi $\frac{1}{2}$ ", Kalat $\frac{1}{2}$ ", etc. The monsoon began to withdraw from the country about the 19th September, and thereafter the weather continued to be dry till the end of October.

With the withdrawal of the monsoon, there was a rapid fall of atmospheric humidity in the Rajputana area, accompanied by a sharp rise in temperature, maxima upto 105°F . being recorded, leading to the development of a zone of high saturation deficiency. Easterly and north-easterly winds generally prevailed in October and November.

Under the influence of a cyclonic storm which developed in the south-eastern part of the Arabian Sea and travelled north towards the Kathiawar coast between the 13th and the 16th November, some rainfall occurred in parts of Sind and Rajputana. Badin 0·60", Chhor 1", Jodhpur 0·70" and Bikaner 0·50".

Western disturbances began to appear in the last week of October, but were generally feeble. In the latter half of November, however, rainfall was recorded, in several places in the Persian Gulf area: Bushire 3", Jask $1\frac{1}{4}$ ", Bahrein 1", Charbar $\frac{1}{2}$ " and Muscat $\frac{1}{2}$ ".

Results of Locust Survey Work in 1936.

1. *Distribution of locusts during the winter and spring seasons.*—In the western 'rek' areas of the Melran Coast, viz., Ormara, Pasni and Gwadar, and in Kulaneh and Dasht, locusts were present in fairly good numbers during December 1935 and January 1936, and the population was composed partly of the remnants of the July migrants of 1935 and partly of the November migrants of the new generation from the Rajputana areas. In the summer rain areas of Lasbela and Sind-Rajputana desert, there were few locusts to be seen in the Sardarshahr and Nokh areas, but around Chachro and Ambagh and in the Mohangarh-Basanpir region of the Jaisalmer area, there were fair numbers of locusts to be found during December, January and February, whereas during the previous year these areas were more or less clear of locusts. By April and May, however, most of the locusts had disappeared in these places, presumably by migration elsewhere.

2. *Breeding in the Winter Rainfall areas.*—The first heavy shower ($1\cdot32$ ") was received at Pasni on the 9th January and the first egg-laying probably occurred towards the end of January. The first hoppers (including I and II instar ones) were detected by the survey staff on 21st March, and the first adult of the new generation was noted on the 18th April. It is likely, therefore, that the earliest hoppers had emerged by the end of February or at the

beginning of March. As the rainfall was below normal, breeding was rather scanty and was more or less confined to the special areas. The last hopper was seen on the 18th May whereas during the year previous, hoppers were noticeable on the special areas even upto the first fortnight of November. The contrast between these two years in this matter is obviously to be attributed to the difference in the amount of the rainfall and the consequent difference in the moisture-content of the soil and the sub-soil.

Egg-laying occurred almost at the same time at Gwadar, Pishukan, Jiwani and Ormara, and the first adult of the new generation was noted on the 11th April at Jiwani and on the 19th in the Ormara area. In Kulanch, a fair number of hoppers was noticed in various places, viz., Kandasole, Sardasht, Ban, and Nokbur during March and April and part of May. In the Dasht area, hoppers were found only in the neighbourhood of Suntsar.

In Kolwa, fairly good numbers of locusts were noticed by the Turbat Fieldman during the third week of March all over the valley between Hoshab and Awaran, but unfortunately this area was not visited again till the middle of June. It was found subsequently by enquiries made of the local inhabitants that hoppers of the *gregaria* type had appeared on a young *juari* crop at Rodkan in Kolwa by the end of March and had attacked the crop. It was reported that after rainfall at the end of February, a fair number of brown-coloured locusts (about 100) were found flying about and pairing in a field and these had presumably laid eggs, from which large numbers of black-coloured hoppers hatched out. The hoppers are reported to have turned green at a later stage, and to have transformed by the end of April into pinkish adults, which flew away within a week of acquiring wings. Obviously this is an interesting instance, wherein an 'out-break' centre had developed by the concentration of migrants of the old over-wintered generation, derived from the coastal reks. The migration may be presumed to have been caused by want of sufficient rainfall along the coast and to have been helped by the strong westerly wind accompanying the passage of western disturbances.

Another place where hoppers were noticed in the interior of Mekran this year was at Nigor Kan Daf near Thana Daragh in the Panjgur area, where 65 hoppers of green colour were found on "Kapochum" (*Chrozophora* sp.) bushes in the midst of a *Juari* field on the 25th June. They were of I, II and III stages. They evidently represented the second generation of the season, the eggs having been laid in the latter half of May, presumably after the thunder-shower rain recorded on the 19th May at Panjgur. The Survey Assistant, who visited this place about a fortnight later, found about 16 hoppers of the III and IV stages. There is little doubt that, in a year of heavier rainfall and consequent greater multiplication of the locust, this place would have functioned as one of the "outbreak" centres.

Hoppers were not observed anywhere in Mekran after May with the exception of the instance mentioned above. Since, however, the Fieldman during his visit in August collected a specimen with hyaline wings between Rodkan and Hoshab on the 9th August, and since some rainfall is known to have occurred in parts of Kolwa in the middle of June, it is presumed that some slight breeding had taken place in Kolwa during summer. The collection of one or

two clear-winged specimens evidently of recent origin in August in the Ormara and Gwadar areas, would also possibly indicate that some breeding had taken place in the valleys of the hinterland.

In April-May, an attempt was made to study the history of the hopper population in a part of the "rek" area at Pasni. A plot measuring about 500 sq. yards in the Gandhako area containing flourishing 'Marand' bushes which was naturally shut off on all sides by walls of moving dunes, was intensively examined periodically, the hoppers being re-released, after noting the actual population. On the 23rd April, 13 hoppers of I, II and III stages were noted, on the 28th, only 5 green hoppers of I, II and IV instars were to be seen, on the 8th only two III stage hoppers and on the 14th, none were to be found. Since the decline in population could not be ascribed to a scattering or a migration of the hoppers, it is surmised by the Assistant Entomologist that it must have been due to the activities of natural enemies, especially lizards, centipedes, ants and spiders.

3. *Distribution of locusts in May and June.*— During May, a gradual diminution of population was noticeable on the Pasni reks, in spite of the appearance of the new generation of adults after the occurrence of local breeding. On the other hand, at Ambagh the locust population was gradually on the increase during May. At Chachro, it was noted that, while only one locust was seen during the first fortnight of May, as many as nine specimens (denoting a population rate of 50 to 320 per sq. mile) were noted during the latter half of the month. During June, the population had considerably increased both at Ambagh and Chachro, while at Nokh fair numbers of locusts were noticeable during June, the first specimen being seen on the 31st May after an interval of complete absence of over two months. At Sardarshahr, the first specimen was found on the 21st June. At Pasni, a sudden increase in the population was noticed from the 28th May onwards, the density rate rising from about 70 to 100 per sq. mile to 300 to 700 per sq. mile. The specimens noticeable were moreover characterised generally by the presence of a more or less pronounced patch of light pink, blue or mauve colour at the base, and the presence in many of the larvae of red mites on the wings. A similar sudden rise in population was noticed also at Ambagh from the 27th May onwards, the specimens similarly carrying red mites and bearing the colour patch at their wing-bases. A rise in population was noticed at Chachro from the 9th June, and at Nokh from the 11th June. At Gwadar an increase in the numbers observed was noticeable about the 26th May, while in the Ormara area the Survey Assistant noted a fairly dense population in some localities during the middle of June varying from 200 to 1,000 per sq. mile, and the specimens are said to have carried red mites and to have possessed blue or mauve bases. He also reports that the Naib of Ormara had informed him that a sudden increase of locusts had been noticed on the 2nd June in the neighbourhood of Ormara. All the above data appear to indicate that an incursion of locusts had taken place over a wide area, similar to that of July 1935, but of very much lower magnitude and intensity. A study of the meteorological conditions of the interior areas of Baluchistan as represented by the reporting stations of Nokkundi, Dalbandin and Panjgur showed that, while the general temperature and humidity conditions of these areas were fairly moderate

upto the end of April, an accentuation of the conditions was noticeable during the second week of May, the temperature maxima reaching 109° to 115°F., and the Relative Humidity percentages generally ranging from 25 to 50 at 8 A.M. in the mornings, and these conditions were maintained till the 23rd June, when conditions were somewhat changed by a temporary extension of the influence of the monsoon in this area. It is presumed that locusts reaching this area in May-June from the coastal rek areas of British and Iranian Baluchistan were deflected south-eastwards, and caused to migrate into the coastal reks of Mekran and Lasbela and subsequently, therefrom, into the Indian areas, entry into which would be facilitated by the strong south-west winds. A biometrical examination of the forms found in May-June showed a preponderance of intermediate ratios and of six-striped forms

4. *Breeding in Summer Rainfall Areas*.—During the spring months, one second-stage hopper was noted on 'Kullichk' (*Cyperus*) at Khandewari in the west Lasbela area during April, and indicates that slight breeding had occurred in this area in spring. One IV-stage hopper was found on 'Booh' (*Aerua javanica*) between Tarana and Mohangarh in the Jaisalmer area on the 24th April, and this indicates that some slight breeding had taken place in this area also, under the influence of about $\frac{1}{2}$ inch rain received in the Mohangarh area in February. In the Dera Ghazi Khan area, good numbers of green hoppers were met with in April and May on *Aerua javanica*. In the same area hoppers were found also in summer, during September, feeding on *Aerua*, *Tribulus* and *Indigofera* (Bekkar).

During June, locusts with blue or mauve wing-bases, presumed to be migrants from the western breeding areas, were found distributed all over the desert areas in small numbers. After the fall of rain by the last week of June the mauve tinge was lost and the wings assumed a bright yellow colour, indicative of maturity.

Egg-laying occurred wherever there had been good rainfall. In considering the extent and the intensity of the breeding that occurred this year in the Sind-Rajputana area, the best method would be to follow the order of the rainfall.

Though the monsoon commenced early this year, the first showers received were in the shape of thunder-storm rain between the 20th and the 26th June. At the end of June, a depression which travelled across the desert gave general rainfall over the whole area between the 29th June and the 4th July, but good falls were recorded only in rather restricted areas. In the Bikaner region, the area of rainfall was confined to a long strip 30 to 40 miles broad passing along the line Mahajan-Bikaner-Srikolayat-Jodhpur, both Nokh and Sardarshahr on either side of this strip not having received any considerable rain. Good rain fell all over the Thar-Mallani areas in the south, and also in parts of the Jaisalmer area. The third burst of rain occurred in the middle of August, when very heavy rains were received in the course of a week (10 to 16 inches) in a rather restricted area enclosing Nokh, Girasar, Srikolayatji, Bikaner, Surpura, Sri Dungargarh and Ratangarh. Localities surrounding this area also received fairly good rainfall, though in smaller amounts. There was little rainfall, however, in the southern area at this time.

The fourth round of rainfall occurred in the first fortnight of September, when under the influence of a depression fairly good falls were received in South Marwar and southern Sind.

(1) *First batch of Breeding.*—On the 28th and the 30th July some V-instar hoppers were found at Girasar and Srikolayat, which evidently belonged to the earliest batch of egg-laying that had occurred soon after the first showers received about the period—20th to 25th June. Younger hoppers were also found, probably belonging to later batches of eggs laid after the rainfall of 30th June. In the Chachro area, the first hoppers (II-instar) were noticed on the 3rd August, though the first adult of the new generation was found there on the 10th August. At Hayat-jo-Tar in the southern Thar area, an adult of the new brood was noticed as early as the 3rd August, which would indicate that eggs had been laid soon after the first thundershowers received about the 22nd June. In the east Jaisalmer area, the first adult was noted on the 19th August and around Barmer on the 17th. Hoppers of various stages were observable in the Chachro area till the end of August, and since I-instar hoppers were found as late as the 21st August, it is evident that egg-laying had been continuing for 5 to 6 weeks after the last heavy fall of the 1st July.

(2) *The Second batch of Breeding.*—The second batch was found associated with the heavy rainfall of August in the Bikaner area. At Nokh and at Sardarshahr Outposts, locusts were not observable during the greater part of July and the first week of August, but with the commencement of rains about the 8th August, they began to be met with in good numbers in these places. In the beginning, the locust population consisted almost entirely of yellow-winged individuals of the old generation, which began to lay eggs immediately. It is surmised that these locusts had been brought in here from some other area by the high winds that accompanied the passage of the depression. During the latter half of August, individuals of the new generation were also met with at Nokh and Sardarshahr, some of which were found to have mature eggs, and indeed showed clear evidences of having laid eggs by the end of August and the beginning of September. It is evident, therefore, that there has been an overlapping of generations among the hoppers noticed in September, part of which were of the first generation, and the rest belonged to the second generation of the season. During September, quite large numbers of hoppers were found in many places, especially in the Bikaner, east Jaisalmer and Bahawalpore desert areas, though gregarious hoppers were not encountered anywhere.

(3) *The Third Batch of Breeding.*—With the fall of 1.25" on 10th Sept. at Chachro, oviposition seems to have occurred in the Chachro area, leading to the appearance of I-stage hoppers at the end of September and the beginning of October. Hoppers were being met with at Chachro till the end of October. Similar breeding would appear to have occurred to a small extent in parts of Thar and Mallani. The hoppers in this area definitely represent the second generation of the season.

Similar rainfall would appear to have fallen in parts of Jaisalmer and Bikaner in September and led to an extension of breeding into November.

Quite large numbers of hoppers were noticeable in the Bikaner-Jaisalmer area throughout October, and there is little doubt that for the most part they represent the second generation of summer breeding.

There was some rainfall in November in many parts of the desert area but it is unlikely that it will lead to any further breeding owing to the setting in of winter conditions.

Breeding in the Lasbela Area.—Light rainfall occurred on the 25th June, and again during the first week of July (1.32 in.) This led to light breeding in the neighbourhood of Ambagh in July-August, and the appearance of new generation adults about the middle of August. Somewhat heavier breeding would appear to have occurred in the Got Sher Khan area to the north of Ambagh.

4. *Distribution of Locusts in the Autumn.*—With the withdrawal of the monsoon by the 19th September, a great change was noticeable in the general meteorological conditions of the Sind-Rajputana area. This was studied by Mr. Bhatia at Chachro during the current year, and the following observations were made:—

Month and date	Open Black Pulb 2" above ground Aver. Max. tempera- ture.	Screen Av. Max. tempera- ture	Screen Av. Min Rel Humidity	Screen Evapora- tion	Rain	Wind Direction	
						Morning	After- noon
September 7-12 ix ..	118-25 F	91-67 F	55%	8-01	1.25 in (10-ix)	(Storm direction N & N. E.)	
13 18 ix ..	120-78 F	93-17 F	40%	13 63 c. c.	Nil	S. W.	S. W.
19 24 ix ..	124-11 F	97-40 F	39%	14-15 c. c.	Nil	North	S. W.
25 30 ix ..	131-13 F	106-43 F	26%	19-65 c. c.	Nil	N, N. E. (Dust storm on 25 ix N. E.)	S. W.
October—							
1-6 x ..	127-83 F	104-60 F	23%	16 28 c. c.	Nil	N. E.	S. W.
7-12 x ..	121-70 F	98-78 F	30%	16-40 c. c.	Nil	S. S. W.	E. S. W.
13 18 x ..	125-10 F	99-70 F	25%	13-70 c. c.	Nil	E. N. W.	W. S. W.
25-31 x ..	122-23 F	99-40 F	19%	16 80 c. c.	Nil	E., N. E.	N. N. E. N. W.

These observations indicate that there was a considerable rise in the general temperature maxima, in the solar temperatures affecting the soil surface, and in the general evaporative power of the atmosphere, as well as a considerable drop in the relative humidity of the atmosphere. Conditions were thus obviously adverse for an animal living on the surface of sandy soils like the locust, and it is presumed that these would confluence to cause it to rise high into the air, where the prevailing wind-direction would govern its further movements.

The conditions analysed above were more or less typical of the situation throughout the desert areas at this time of the year, the degree of development of the various factors, of course, varying with local conditions of rainfall and vegetation. At Chachro, the locust population was fairly dense till the 24th, but on the 25th, Mr. Bhatia reports, there was a fairly heavy storm coming into Chachro from the north-east in the evening, and after this date the local locust population almost vanished completely, since only 11 individuals were noted during surveys in the course of the next two months. Similarly at Nokh and Sardarshahr also, the population density was very low during the latter half of September and the early part of October, though hoppers were being met with in good numbers. In these areas, however, the population began to increase during the latter half of October, and during November the density was greater yet, by reason of the appearance of the adults of the second generation. Apparently the atmospheric conditions during November had greatly improved by the general fall of day temperatures, and, though the humidity was low, the urge for migration was apparently not much felt. It would be of interest to watch the further history of these large populations at present to be found in the northern part of the Indian Desert, and to determine whether these would migrate west at the end of the cold season or move north, east or south, in February-March.

At Ambagh, Mr. Batra noted a slight rise in population during the surveys carried out in the latter half of September, and on the 28th and the 30th, the rise was definitely pronounced reaching 500 per sq. mile. The forms were also found to have mauve wing-bases and to carry mites, and were evidently migrants, and when the rise in population at Ambagh is coupled with the reported disappearance of locusts from the Chachro area, after the 25th September, the inference to be made is rather suggestive of the origin of the migrants from the Thar-Mallani area. Surveys at Ambagh showed that the migration was continued throughout October, though at the end of the month there was a specially large rise between the 28th and the 30th. The increase in the number of migrants was maintained throughout November. At the beginning of November two forms with 8 eye-stripes were noted among the migrants, as also one form carrying Tyroglyphid mites on its body. These facts are rather interesting, since the only region where 8-stripped forms were found in nature was the west Bikaner area this season, and Tyroglyphid mites were also noted mostly in the Bikaner-Jaisalmer region.

At Pasni, a small incursion was noticed between the 19th and the 26th September, and this is probably to be correlated with certain duststorms that prevailed in the middle of September in Baluchistan, and had been observed and recorded by the Fieldmen then touring in parts of Kolwa and Lashela. The main direction of the storms was from the north-east to south-west, and it is presumed that it was some of the earliest migrants to arrive with these winds that had been recorded at Pasni in the latter half of September. A second small incursion of new generation locusts was detected during surveys in the early part of October, and it is possible that these were part of the contingent recorded by Mr. Batra at the end of September.

Dr. Roonwal reports that at the end of October a fairly defined immigration of clear-winged locusts which had attracted even the notice of people

at Pasni was recorded by the survey staff. As the incursion continued even in November, it is possibly contemporaneous with the October-November incursion at Ambaghi.

Similar migrants were noted by the Survey Fieldman during October and November in the Ormara area, and during November in the Gwadar area.

5. *Confirmation of the Phenomenon of migration among the Solitaires.*— From the statements made above, it is clear that in May and June, there had been a migration from the western winter rain areas into the eastern regions subject to summer rainfall, and in the autumn months, i.e., between September and November, a return migration from the desert areas into the western rek areas.

In deciding whether a locust specimen collected in the field is a migrant or not, reliance has been placed on some of the following characters:—

1. Any decided differences in the biometrical and physical characters of the specimens from those of the local population of the place at the time being, e.g., in the ratios, in the eye-stripe characters, in the general colour, etc.
2. The occurrence of external parasites. The occurrence of red mites, i.e., the larval stages of *Trombidium grandissimum* (?), is one of the indications that the specimen had been living for some time past in a region where good rainfall had occurred.
3. The colour of the wing: Hyaline colour would indicate a recently developed generation, while deep yellow, a state of sex-maturity. In many migrating specimens patches of pink, blue or mauve are often seen at the base of the wing, which appear to vary in intensity with the length of time they have been on the wing and with the degree of brightness of the sun-light.

In regard to the development of pink or mauve colour at the base of the hind-wing, certain experiments were devised in order to find whether it can be attributed to the effect of the play of the sun's rays during the period of active flight. Statement—L—1 summarises the results of these experiments.

While examining some of the locusts in a cage kept in the sun, during my visit to Pasni in May 1936, I observed that the hind-wing under the malformed elytron of one of the locusts showed a definite tinge of pink. This observation suggested the idea of removing the elytra of some of the locusts to note the effect of exposure to the sun's rays. A cage 3 ft. square by 3 ft. high was therefore, set up at Pasni, in which some recently transformed locusts were introduced after having their right elytra removed, as also certain others, both the elytra of which had been excised. The cage was kept in the open fully exposed to the sun, which was very bright and hot during May and June. The course of a week or two, it was found that in all cases the wings exposed to the sun had acquired a pink colour, which gradually deepened into mauve. By July, with the appearance of cloudy weather, both pink and mauve disappeared completely with the onset of yellow colour indicating maturity. In the case of specimens in which only the right elytra had been removed, the appearance of a tinge of pink or mauve was noted even under the left elytron, though, of course, the colour was by no means as intense.

These experiments were repeated again at Panni in November-December with fairly conclusive results.

Experiments on similar lines were carried out at Karachi and Ambagh. The first set of experiments, which were set up at the end of June, gave only negative results both at Ambagh and Karachi, as with the advent of monsoonish weather characterised by conditions of high humidity and lack of sun-shine the wings rapidly assumed a bright yellow colour.

In the second and third sets, carried out in September and November respectively, the development of pink or mauve colour was definitely noted in the course of 2 to 4 weeks in many of the specimens. At Karachi, the results were not so decisive as at Ambagh, as on account of the existence of high buildings all round the place where the cages were kept, the locusts were not getting sufficient sun-shine except during mid-day.

On the whole, however, these experiments have shown that exposure to sunlight may lead to the definite development of pink or mauve in the wings, so that the existence of pink or mauve at the base of the wings may correctly be taken to be an indication that the locust in question had been undergoing an active migration flight.

7. *The occurrence of External Parasites on locusts.*—Locusts have been known to be subject to the attacks of red mites. These are the larvae of the Velvet Mite—*Trombidium grandissimum*, which appears in large numbers on the ground soon after the first heavy fall of the season. After pairing and leading an active life on the surface of the ground for some time, it disappears entirely, presumably by burrowing into the sandy soil. Eggs are probably laid in the soil, and the larval mites on hatching actively search for their hosts, which are mainly locusts and grasshoppers. They attach themselves to the wings and feed on their blood. When fully bloated, they drop off for undergoing their further life-history. The young mites appear about a month after the first heavy fall, and may attach themselves to any locust, whether of the new or the old generation, that may be present at the time. Locusts of the second generation are generally free from mites. The presence of a locust specimen carrying red mites in an area where there has been no recent fall of rain ought therefore to be taken to be an indication of migration.

A second kind of mite was noted this year on locusts in the Sind-Rajputana area, and this mite, which has been provisionally classified at the British Museum as a Tyroglyphid, has the habit of living in small colonies on the meso- and meta-notal areas, and at the base of the wings of the locust. Groups of eggs, young mites or their empty moults may be seen crowded together on their bodies. This mite was first noticed at Sardarshahr, and has, subsequently, been found in other places in the desert area. This mite has so far not been noted in Baluchistan, and the presence of a locust with a colony of this mite on its body at Ambagh among specimens collected during surveys made at the beginning of November, may therefore be taken as a presumptive evidence of the occurrence of migration.

8. *Liberation of marked locusts.*—The system adopted last year of marking the month and the fortnight of liberation on the wings of the locust with

cellulose paints and of tying coloured silk thread on the femora in addition, was followed during the current year in most of the locust observation stations at those times when locusts were present in good numbers.

During 1935 and 1936, altogether about 1,400 were thus liberated, but of these only 28 specimens, or about 2 per cent. have been recovered.

The details of liberation and recovery may be summarily shown as below :—

Year.	Locality of liberation	Number liberated.	Number recovered.	Month of recovery.
WESTERN REK AREAS.				
1935 ..	Pasni (about) ..	404	11	Jan., Feb., Mar., Apl., May and July.
1936 ..	Pasni ..	156	3	March—May.
1936 ..	Gwadar-Jiwani ..	63	1	October (4-5 miles).
1936 ..	Ormara ..	18	nil	
EASTERN OR SUMMER RAIN AREAS.				
1935 ..	Ambagh ..	220	9	March, May, Sept., Oct November.
1935 ..	Chachro ..	47	3	Dec., Jan., March
1936 ..	Chachro ..	85	nil	
1935 ..	Barmer ..	100	nil	
1935 ..	Nokh ..	30	nil	
1936 ..	Nokh ..	205	1	November (about $\frac{1}{2}$ mile). ..
1936 ..	Sardarshahi ..	15	nil	

(NOTE —A full statement of the liberations made is given in Statement M.)

Of the recoveries made, only two cases were of real value viz., one captured at Rumra 20 miles off from Pasni on the 17th May 1935, and a second one recovered on the 2nd October 1936 about 4 or 5 miles from the place of liberation in the Gwadar Rek areas. It is rather significant that both these cases were during months when active migration usually occurs.

In regard to the other cases of recaptures, they were all found not far from the place of liberation. It is rather noteworthy that many of these cases occurred during the winter months, when little migratory activity need be expected. The fact, however, that 98 per cent. of the locusts liberated were not traceable would indicate that at least some of the locusts released had migrated. As intensive surveys are being made only around the observation centres, and the touring staff are limited, the chances of the recovery of marked locusts in the vast sparsely populated spaces lying between

the centres of observation are rather remote. Mr. Batra reports that he tried a system of giving rewards to cases of recapture of marked locusts and circulated the information among the officers of the Lashela State, but did not meet with any response.

In view of the importance of obtaining exact knowledge in regard to the direction taken by the migrants at different parts of the year, it would be advisable to intensify work in this direction.

9. *Number of generations in the year.*—It would appear that there was only one generation on the coastal areas of Mekran this year. In the interior of Mekran, the hoppers found in June-July at Thana Daragh were probably the second generation of the season. The hyaline-winged form collected in Kolwa in August is also probably an instance of the second generation, though there is no direct indication as to where the breeding had taken place.

In the summer rain areas, light breeding was recorded in Dera Ghazi Khan in April-May, as also to a slighter extent in the western reks of Lashela and in the Mohangarh area of Jaisalmer.

In the Sind-Rajputana desert areas, the earliest adult of the first summer generation was observed as early as the 3rd August, and some of the adults of the first generation had laid eggs by the beginning of September.

The earliest adults of the second generation appeared in the course of October. A third generation should not be considered to be beyond the bounds of possibility, as a fair amount of rainfall occurred in November, but is rather improbable owing to the considerable drop in the diurnal temperatures.

10. *Other locusts met with during surveys.*—(a) *Patanga succincta*.—Mr. D. R. Bhatia collected a specimen of the Bombay Locust on the 7th November between Sonpalsar and Sardarshahr in the Bikaner States; and two more specimens on the 20th November at Girasar in east Jaisalmer. The yellowish green colour of the stripes of the specimens collected was rather remarkable.

(b) *Locusta migratoria* ph. *solitaria*.—Quite large numbers were noticed in many localities in the summer rain areas this year.

1. Kachhi area in Baluchistan and Dadu District in Sind. Quite good numbers were noted in July, as many as 100 specimens being observable in some Juari fields.
2. Mallani area : 4 specimens in August.
3. Thar area in Sind : 9 specimens in August-September.
4. Jaisalmer area : 22 specimens in November.
5. Bikaner area : 10 in August, September and November.

It is rather noteworthy that specimens of the Migratory Locust should have been met with in the desert areas during the monsoon period, only and it would be rather interesting to find out whether this species also undergoes migratory flights in the "solitaria" phase.

The presence of large numbers of this locust in July among Juari fields is rather striking, and an investigation of its breeding habits should be useful in view of the recent expansion of agriculture in Sind.

IV.—ECOLOGICAL STUDIES.

1. *Meteorological and bio-climatic observations.*—The results of the meteorological observations made during the year at Pasni, Ambagh, Chachro, Nokh and Sardarshahr are given in Statements F-I, F-II, F-III, F-IV and F-V respectively.

Pasni Locust Research Station.—A new meteorological area was laid out as per plan kindly furnished by the Agricultural Meteorologist, Poona and the screens and the various instruments were set up. The new additional equipment ordered for arrived in the course of the year and were set up in their places. The equipment included a Thermo-hygrograph, a Sunshine-Recorder (Whipple-Casella), Wet-maximum and Wet-minimum Thermometers, a Grass-minimum thermometer, and an Assmann Psychrometer. The Anemometer was out of order during the greater part of the year, and as attempts towards repairing it failed, an order has been placed for an instrument of the latest pattern like the one used by the India Meteorological Department.

As decided at the Meeting of the Locust Committee this year, self-recording Hygrometers were ordered for the Desert Outposts at Chachro, Nokh and Sardarshahr, and have been in use since September-October.

2. *Vegetational Studies.*—Records have been made of the typical vegetation prevailing in the Mekran reks and the Rajputana desert areas by the Plant Quadrat method, and notes have been taken in regard to the appearance of the annuals. Much information has been obtained in regard to the food-plants preferred as food by the hoppers in the Sind-Rajputana area.

3. *Locust Breeding at the various centres:*—(i) *Pasni.*—The rainfall in the winter-spring season was below the average. Rainfall in January, February and March was 1.62", 0.83" and 0.96" respectively. The first hopper was observed on the 21st March, and the last one on the 18th May. The first adult of the new generation was found on the 18th April. The breeding was very much restricted.

(ii) *Ambagh.*—In spite of a fall of 0.95" of rain in February, there was no breeding in the reks. During the monsoon, the rainfall was limited to 0.38" at the end of June and 1.32" at the beginning of July. There was no further rainfall during the year. The first hopper was noted about the middle of August, and the breeding was extremely limited.

(iii) *Chachro.*—The first fall of the year was received at the end of June and amounted to 0.34". In July 4.62" were recorded, of which the main fall (3.87") was on the 1st July. 0.06", 1.25" and 1.22" were recorded during August, September and November respectively. The first adults of the new brood were collected on the 11th August, which would indicate that the first oviposition had occurred soon after the rain in June. Hoppers noted in October were apparently representatives of the II generation produced after the September rainfall.

(iv) *Nokh*.—There were light falls amounting to 0.31" and 1.37" during June and July, which resulted in very light breeding. In August, very heavy falls of rain were recorded amounting in all to 16.36", of which the biggest fall was 5.01" on the 13th August. There were light falls in September and November amounting respectively 0.69" to 0.84". Large numbers of hoppers were found in September and October, and a few also in November. The hoppers found late in the season represented the second generation.

(v) *Sardarshahr*.—A fall of 0.84" was recorded on the 26th February. Rainfall in June and July was light, 0.70" and 0.92" respectively, and did not lead to any breeding. In August, there was a total fall of 2.74" and led to the emergence of a moderate number of hoppers in September. Hoppers were noticeable till the last week of October. There was very little rain in September, October and November.

4. *Natural Enemies*.—(i) An *Asilid* fly was found very common in the Rajputana desert areas during the monsoon months, and was found attacking and preying on various insects, among which the hoppers of *Schistocerca* and certain grasshoppers were included. From its active habits and its keen powers of sight, it would appear to be an efficient predator.

(ii) At Pasni, a large black *Sphegid* was found chasing a locust on the wing, on 30th May, for nearly 5 minutes without eventually capturing it.

(iii) As already mentioned, a *Tyroglyphid* mite was found parasitising locusts in the Rajputana area.

(iv) The following lizards found in the desert areas were identified :—

1. *Acanthodactylus cantoris cantoris*.—Common in the Mekran reks and in the Sind-Rajputana areas. Attacks hoppers.
2. *Agama agilis*.—Mekran reks ; attacking hoppers.
3. *Agama minor*.—Rajputana deserts.
4. *Calotes versicolor*.—Rajputana deserts : the common "Blood sucker", or "Girghoot".
5. *Phrynocephalus ornatus* (?) :—Mekran reks.
6. *Eumeces schneideri* :—Pasni reks : V-instar hoppers found among the stomach contents.
7. *Varanus griseus*.—Common on the reks of Mekran and Lasbela.

PART II.

EXPERIMENTAL STUDIES ON THE LIFE-CYCLE OF THE DESERT LOCUST.

The following experiments were undertaken during the year mainly at Pasni, some of them being carried out in part also at Ambagh or Chachro :—

1. *The number of generations possible during the year under semi-natural conditions.*—Pasni and Ambagh.
2. *The influence of the quality of food on the sex-maturation of the Locust.*—Pasni and Ambagh.
3. *The influence of the quality of food on the growth of the hoppers.*—Pasni and Ambagh.
4. *The food preferences of the Locust ; Pasni for the ' rek ' vegetation, and Chachro for the " desert " food-plants.*
5. *The colouration of adults and hoppers in relation to the change of environment.*—Pasni and Karachi.
6. *A study of the development of the eye-stripes among hoppers.*—Pasni, Ambagh and Karachi.
7. *The length of the incubation period under semi-natural conditions.*

1. NUMBER OF GENERATIONS POSSIBLE DURING A YEAR.—This year, the generation experiments were started with a pair that laid eggs on the 20th November 1935, as shown in Statement I-(a) from a reference to which it will also be found that on the 24th November 1935, a female belonging to the third generation had laid eggs and this started the fourth generation of the year. It is evident, however, that, in view of the approaching advent of cold weather conditions, the fourth generation would not be able to reach maturity till next February, so that practically under the conditions at Pasni only three full generations and a part only of the fourth should be deemed possible during the year. As may be evident from the figures given for Ambagh in Statement I-(a) the experience there this year has been similar.

In fact, as may be seen by a perusal of Statement I-(b) where the results of the last four years' experiments (1933—36) are given, four full generations have never been completed within 12 months in any year, and the utmost that can be conceded would probably be about 7 generations in the course of 24 months.

Notwithstanding the above considerations, there is the possibility that the locust, by virtue of its powers of long distance migrations, might be able to benefit by the vastly different conditions existent in distant regional areas to pass through 3 or 4 successive generations during the year in nature. For instance, during May-June, the conditions in the interior of Mekran would be very different from those of the coastal reks. Higher temperatures would be prevailing there at that time, and in places where rain had fallen, the conditions of humidity would also be optimum for development. Since in outbreak areas the gregarious hoppers have always been found among cultivation, the humid micro-climatic conditions of the Juari crop should be quite favourable for the rapid growth of the hoppers, and the second generation of the locust may be expected to be completed much quicker than under caged conditions at Pasni.

Again, the migrants from Mekran in summer would, in the event of early rainfall, similarly find, on reaching the Rajputana area, conditions favourable for early growth and maturity, as had actually been noticed to have happened this year in the desert areas. On receipt of early thunderstorm rains between the 20th and the 25th June, egg-laying had commenced almost immediately with the result that fifth stage hoppers were noticeable by the last week of July and the earliest adults were seen by the first week of August.

Since one of the main factors in the causation of locust infestations is the development of conditions favouring rapid multiplication by bringing about a rapid succession of generations, it is important that the different generations as they arise in nature should be recognised and clearly distinguished. Under natural conditions, however, the same female may lay two or more successive batches of eggs at intervals, leading to the development of a hopper population of different ages, and ultimately bringing about an overlapping of generations, so that it is not an easy matter then to make a clear analysis of the situation. If, however, generation experiments of the kind under discussion were in progress at typical centres of the different regions, they would help one a great deal in reading the situation aright.

It is therefore suggested that, instead of starting the experiments at an unnatural time, they might be begun with pairs secured from nature at a time when under favourable conditions breeding might be expected naturally to begin in the area concerned. If carried through the season, as was done this year at Chachro, they might be expected to give definite clues to the correct understanding of locust breeding in particular areas. This year, it is proposed to try this system at Pasni, the pairs being secured at the beginning of the breeding season, viz., December-April.

Generation experiments on a large scale were also started early in the year in some of the field-cages, with the idea of determining how rapidly a mass population could be built up in the course of the year. The first generation had been followed, as also a part of the second by April-May, when they came to an abrupt end on account of the persistent inroads of ants inside the cages, which could not be checked in spite of treatment with calcium cyanide.

II.—EXPERIMENTS ON THE INFLUENCE OF THE QUALITY OF FOOD ON SEX-MATURATION.

Statement G-I shows the results of the experiments carried out in the summer of 1935 and included in last year's report, and G-II the results of the autumn of 1935 (which were yet incomplete last December). During 1936 the experiments were restricted as recommended by the Locust Committee to the important food-plants of the locust, and to comparative observations on the effect of fresh and old *Marrad* and of fresh and old *Kharzan*. The results of the summer 1936 set of experiments at Pasni are given in Statement G-III, while those of similar experiments conducted at Ambagh with *Kharzan*, *Balibur* and *Juari* during 1936 are given in G-IV. In addition, females kept in cages improvised with a large glass chimney and wire-gauze were fed on the different plants at Pasni, and the faeces passed by them each day were separately collected and weighed after drying them in a water-bath. The results of this experiment are shown in Statement G-V.

The results noted in Statements G-I, G-II, G-III and G-IV have been tabulated below for purposes of comparison.

N.B.—In the Table given below 'A' stands for the "Time taken for the development of yellow tinge in the wings: (in days)", and 'B' signifies "Time taken for the first oviposition (in days)".

Serial No.	Nature of Food	Time A & B.	Pasni Summer-35.		Pasni Autumn 35		Pasni Summer-36.		Ambagh 1936		Remarks.
			A	B	A	B	A	B	A	B	
1	Fresh Marrand ..	A	17.6		18.8		16		25		
		B		35		45		37		..	
2	Old Marrand ..	A	25.3		24		17.5		..		
		B		43 1		90		54		..	
3	Jowari ..	A	16.7		13.7		27		..		
		B		22 3		45		36		..	
4	Jowari Seedlings	A	..		..		16		7		
		B	..		..		34		25		
5	Maize	A	..		..		13		..		
		B	..		..		35		..		
6	Kharzan ..	A	23.7		35		27		18		
		B		59 5		85.5		51		35	
7	Old Kharzan ..	A	..		..		..		16		
		B	..		..		..		39		
8	Balibur ..	A	24.8		41.5		20.5		16		
		B		40		104		63		50	
9	Kulchik ..	A	21.5		68		33.2		..		
		B		38.5		100		64		..	

The above results would show that Sorghum (Jowari), Maize, and Jowari seedlings top the list and that Fresh Marrand comes an easy second. It may be noted that while Kharzan has given poor results at Pasni, at Ambagh it has proved as good as Fresh Marrand, and even Old Kharzan has given good results. Balibur too has given slightly better results at Ambagh, and possibly in the Sind-Rajputana areas, where it flourishes best it may show better results.

In regard to the experiment in which the relative quantity of the excreta of female locusts fed on the different food-plants have been determined, it is unfortunate that most of the females should have succumbed to the scorching blast of the dry "Gorich" wind that was recorded at Pasni on the 21st October raising the air temperature to 107° F, so that no records of oviposition could be made. The results recorded in Statement G-V, however, show that in the case of Marrand, Balibur and Kharzan, and especially in the case of

Old Marrand, the average weight of faeces excreted per day per insect is almost twice as great as that of Maize or Jowari. This is only what might be expected, since Marrand, Balibur and Kharzan have weight for weight a much greater percentage of indigestible matter in the shape of spines and hairs than Maize and Jowari, the differences in the water-content not being relatively very considerable. Consequently, the proportion of roughage being greater, a larger quantity of these plants have to be eaten to get the same amount of nutriment as Maize or Jowari leaf. Possibly the greater effect of the Jowari leaf is due to its being more nutritious. The figures of the average shown here are, however, based on the weights worked out for two locusts for each plant, and it would be desirable to have the experiments repeated to secure results of greater reliability.

III.—EXPERIMENTS ON THE INFLUENCE OF THE QUALITY OF FOOD ON THE GROWTH OF THE HOPPERS.

About 30 just-hatched hoppers were kept in the chimney cages above mentioned and fed on the different food-plants, and the faeces passed out by the hoppers of the same stage were carefully collected every day and weighments made after being dried in a water-bath. It was found that all hoppers fed on Jowari, Kharzan and Balibur died in the first stage at Pasni. As in the case of the adult females, the greatest amount of faecal matter was excreted by the hoppers feeding on old Marrand, and the least by those on Maize. Owing to the occurrence of the "Gorich" on the 21st October, a good many of the experimental hoppers perished and many of the experiments were unfortunately cut short.

At Ambagh also experiments on breeding the hoppers on the different food plants were made, but the hoppers were bred individually in separate cages, and no attempts were made to preserve the excreta. At Ambagh, hoppers were successfully reared on Jowari, Kharzan, Balibur and Marrand, and it was only in the case of Mazoung, most of the hoppers died. The relative length of the larval period in the case of the various food-plants is given below for comparison :—

Locality.	Fresh Marrand.	Old Marrand.	Kul. lichk.	Balibur.	Kharzan.	Old Kharzan.	Maize.	Jowari Seed-lings.
PASNI.								
Average Length of Larval period.	46.8 days.	53.8 days	60.3 days	all died	all died	..	57.5 days	all died.
Shortest period	38 days.	50 days.	60 days	..	..	..	52 days.	..
AMBAGH.								
Average Length of Larval period.	52 days.	..	..	62.7 days	47.5 days.	51 days	..	40.5 days.
Shortest period	43 days.	..	..	46 days	37 days.	40 days.	..	31 days.

The details of the hopper-feeding experiments at Pasni are given in Statement II-I, while those at Ambagh in Statement II-II.

The percentage of the water-content of the various plants used for food experiments at Pasni was worked out and the results are given in Statement II-III. Of the determinations made, the figures given for Jowari Plant, Jowari seedling and Bajra appear to be rather low, and may be due to the poor quality of Jowari and Bajra seedlings available in the neighbourhood of the Pasni Research Station, as the soils in the vicinity are agriculturally very poor, and the specimens of seedlings obtained for feeding were lanky and thin. It would be advisable to have further weighments made of good specimens.

In future experiments, it would be advisable to calculate separately the length of the hopper period for those undergoing extra moults, as the latter contributes to the prolongation of the larval period by about a week or more.

A. B.—Mr. Tahir Ali Khan was responsible for the food experiments at Pasni.

IV.—FOOD PREFERENCES OF THE LOCUSTS.

1. *Mekran Rek Aucas*.—In order to test the preference of the locusts to particular food-plants, Dr. M. L. Roonwal performed a number of experiments, by trying some of the commonest plants found on the Mekran rekhs as food for hoppers and adult locusts.

In these experiments, cage-bred black hoppers of various stages, excluding the first instar, were liberated in a wiregauze cage 3 ft square and 3 ft. high fitted with a plank bottom. Twigs of the food-plants were placed in small dishes of water, which were arranged in a circle on the floor of the cage. The hoppers were partially starved before the start of each experiment, which was repeated several times, readings being taken at different times of the day and with the same set of plants arranged differently. In this way, chance errors due to phototropism and other causes were eliminated, as far as possible. In each experiment, two counts were taken as a rule, one 15 minutes after the introduction of the hoppers, and the second, about half to one hour later. Notes were made as to the number of hoppers on each food-plant and as to whether they were feeding or not, and the number of hoppers found on each different plant was taken as a measure of the preference of the insect for the particular plant. The results of the various experiments are given in detail in Statement J.

The net results may, however, be shown in the following table, wherein the plants have been arranged in the order of preference by the locusts :—

Serial No	Common Name.	Scientific Name.	Abbreviation used	Remarks
1	Maize ..	<i>Zea mays</i>	Z	No clear preference between (1) and (2)
2	Bajra ..	<i>Pennisetum typhoides</i> ..	P	
3	Kulliohk ..	<i>Cyperus arenarius</i>	C	No clear preference between (3) and (4).
4	Martand ..	<i>Heliotropium undulatum</i> ..	M	
5	Jowari ..	<i>Andropogon corymb</i>	J	
6	Kharzan ..	<i>Sesicordis pauciflorum</i> ..	K	
7	Balibur ..	<i>Aerva javanica</i>	B	
8	Mazoung	<i>Sphaerostoma Hoelers</i> ..	S	

It was found that while Marrand is preferred to Jowari by the hoppers the adults show greater attraction to Jowari than Marrand. Dr. Roonwal thinks that it is desirable that further experiments are needed especially in regard to green hoppers and adults.

2. *Plants of the Indian Desert areas.*—Mr. D. R. Bhatia performed several experiments at Chachro in August and October to find the order of preference shown by hoppers in regard to various plants—cultivated as well as wild usually met within the desert. Fresh specimens of the various food plants were obtained and placed at the bottom and hoppers, either I—stage hoppers or those of the V-instar, were introduced. After 5 hours or more, during which the food-plants were shuffled more than once to eliminate chance preferences, the leaves were examined to find out the extent to which each plant had been eaten.

The following is a general statement of the results obtained by him :—

I.—*Plants absolutely refused.*—‘Ak’ (*Calotropis*) and ‘Neem’—*Azadi rachta indica*, were not eaten by hoppers even after several hours’ starvation, though the adults ate them a little under the stress of starvation. The ‘ovules’ of Ak flowers were, however, found eaten. Other common plants found refused, though not absolutely, were: Bordi (*Zizyphus*), Bavuri (*Acacia sp.*), Murant (*Panicum turgidum*), Jhal (*Sakodora perrica*), Lampdi (*Aristida sp.*), Chibar (*Cucumis trigona*), Tursan (*Citrullus colocynthis*), etc.

II. *Plants preferred best.*—Among the cultivated plants found in the desert areas, Kaling (Water-melon—(*Citrullus vulgaris*), Bajra (*Pennisetum typhoideum*) Til (*Sesamum indicum*), Moth (*Phascolus aconitifolius*), Gwar (*Cyamopsis psoraloides*), and among the wild vegetation, Wekra or Bekkar (*Indigofera cordifolia*), Bishani (*Tephrosia Hookeriana*), Kanti (*Tribulus terrestris*), Bharut (*Cenchrus catharticus*), Bagra (*Gynandropsis pentaphylla*), Santa (*Trianthema pentandra*), Gamol (*Panicum antidotale*) and Siwan (*Elyonurus hirsutus*), etc.

Next in order of preference, the following are reported :—Booh (*Aerua javanica*), Gandhil (*Dactyloctenium scindium* or *Eleusine aristata*), Bhengri (*Blepharis indica*), Phog (*Calligonum polygonoides*), Kuri (*Brachiaria sp.*), etc.

Other plants were but slightly eaten.

Experiments also showed that among the preferred plants, semi-dry plants or specimens which were over-mature were forsaken for others, usually not much liked, if in a green state. The order of preference shown by the experiments was found actually confirmed by observations made in the desert this year. For instance, Wekra and Kanti were usually preferred to Booh when they were in a green flourishing condition, but in October-November when they had become semi-dry, hoppers were found mostly on Booh.

It would be necessary to repeat some of the experiments next year and have the results confirmed.

V. COLOURATION OF ADULTS AND HOPPERS IN RELATION TO A CHANGE OF ENVIRONMENT.

Observations made in nature would show that hoppers found in the field usually assume the general colour of the vegetation in which they happen to live. Those found on Booh (*Aerva*), and Kanti (*Tribulus*) are seen to have a bright ashy blue colour, while those found on Wakra and Marrand are light to dark green. Some found among drying grass have been noted to have a yellow brown or hay colour. Certain field observations made would suggest that such a change of colour usually takes place just after a moult, the colouration of the environment of the time being, being assumed by the hopper. Possibly the colouration of certain hoppers found in nature showing patches of brown on a background of green, is also to be ascribed to such a circumstance.

Dr. Roonwal performed a set of experiments rearing hoppers in small painted boxes, the results of which are given in his own words in Statement O.

The results obtained would seem to show that the colours that can be simulated are limited by the range of colouration tints that can be expected to be found in their natural environment.

In regard to the adults, it has also been noted that locusts recently transformed from the hopper stage usually show the hopper colouration on their prothorax, there being a pattern of light dots on a darker background, without the dorsal and lateral stripes of the adult. At Karachi, it was found that if kept in the shade this colouration persisted for more than ten days, while specimens kept in the sun assumed the stripes fairly soon. Similarly, the eyes of fresh adults transformed from black-coloured hoppers are usually a uniform brown generally without stripes, or if at all, with the stripes very faint. Experiments performed at Pasni (*vide* Statement L-II) have shown this year that in specimens with unstriped eyes kept in the sun, light coloured interstripes gradually appeared converting the eye into a striped one, while in the locusts kept in shade there was no such development. Presumably the stripes are present in all locusts, whether *gregaria* or *solitaria*, and are only masked by a superficial cover of brown. Among the ashy-blue hoppers found on Booh (*Aerva*) the eyes are masked by an ashy-blue colour in which the stripes are seen as faint streaks.

Possibly the appearance of the dorsal stripes and the accentuation of the brown and light patches on the body, as well as the appearance of the eye-stripes have the purpose of making the locust less conspicuous in its natural environment among the scrub vegetation of the "reks". This year a number of locusts with a bright green tinge on the dorsal stripes and on parts of the elytra and thorax were found in August and September in the Rajputana area. Similar forms were also collected in the Lasbela area in July among bright green grassy vegetation. At first, these specimens were thought to be abnormal young forms of the new generation whose chitin had not hardened, but the individuals collected in the Lasbela area were clearly specimens of the migrants found in June, and there was little doubt that the green colour had been recently assumed. It is also remarkable that these green forms could not be seen in October-November when specimens having the dry-grass colour were greatly in evidence. Again, very dark-coloured specimens have in

the past been collected in the 'siab-pat' or black gravel areas of the Mekran hinterland. These instances would appear to indicate that the adult form of *Schistocerca* is possessed of the ability to change its general colouration to a certain extent to suit its environment.

VI.—A STUDY OF THE DEVELOPMENT OF EYE-STRIPES AMONG THE HOPPERS.

In January of the current year, Dr. M. L. Roonwal discovered in the course of an examination of locusts collected in the field that there were two main types of eye-stripes among the Desert Locust specimens met with on the Mekran reks, one with six brown stripes and the other with seven. A note on this discovery was published by him in July 1936 in *Current Science*, Vol. 5, page 24.

With the idea of tracing the development of the eye-stripes in the hopper stages, he followed the rearings of more than 120 isolated hoppers and found that stripes were present in green hoppers even in the first instar. After tracing the development of the stripes in the hoppers, he has come to the following conclusions. As a general rule one stripe is added in each stage of the hopper. The anterior margin of the eye functions as the active growth-region, and the growth of a new stripe takes place during the interval between successive moults. There are two distinct types of development of the eye-stripes. Until the second stage, the development is identical, there being one additional stripe for each moult. In the third stage, only one stripe is added in the six-striped eye, and two in the seven-striped type. In all the subsequent stages, one stripe is added at each normal moult (*vide* Statement P-I). The two types of development may be schematised as below :—

Stage	I.	II.	III.	IV.	V.	Adult.
Number of stripes ..	1	2	3 4	4 5	5 6	6 7

The number of stripes and interstripes during extra moulting may either remain the same or increase by one (*vide* Statement P.-II).

Since the eye-stripe difference is not confined to the adult stage, but extends to the earlier hopper stages (appearing in lots bred under exactly the same conditions), Dr. Roonwal has come to the conclusion that the difference is a deep-seated one.

With the idea that the difference might be a genetic one, he tried crossings between the two types, and is awaiting the emergence of the F.-2 generation for coming to some decisive conclusion.

At Karachi, Dr. S. Mukherji undertook, under my instructions, some breeding experiments to find out if the difference in the stripes could be due to the amount of sun-light to which the hoppers had been subjected during the stage

of their growth. Accordingly a dozen hoppers were kept individually in small wiregauze cages and exposed to sun-light in the open, and another similar set kept in shade inside the office. Two sets of rearings were gone through, but little difference could be found between the hoppers kept in the sun, and those in the shade, so far as stripes were concerned, though those kept in the sun were quicker in development and were healthier. Many of the hoppers kept in the shade died. Incidentally, however, the rearings have proved very interesting, since (as may be seen by a reference to Statement P.-III) his observations would appear to show that the number of stripes in the eye vary directly with the number of moults undergone by the hopper. In all cases of extra moults, he found seven stripes appearing; where there were no extra moults, the number was six; and in one case, an abnormal adult was produced that went through only four instars and had only 5 eye-stripes. He found that, without any exception, one stripe was added at the end of every moult passed through by the hopper.

Mr. R. N. Batra also made observations at Ambagh on the development of eye-stripes in hoppers in the course of his experiments in regard to the effect of Quality of Food on hoppers, and he also found a correlation between the occurrence of the extra moult and seven stripes in the adult (*vide* Statement H-II).

It appears, therefore, necessary that further work should be done for getting a more definite enlightenment on the development of the stripes.

Forms with 8 stripes were found in the Bikaner area occurring in nature, and an examination of the forms has not revealed any abnormality in their structure, while in the course of rearing at Karnachi, nearly 50 specimens with 5 eye-stripes were found to have developed in the cages under conditions of crowding. Some of these were deformed and had crumpled wings, but others were perfect in the proportions of wing and body, but were undersized. These forms were isolated in a cage, and laid eggs. The hoppers that hatched out have developed into healthy hoppers, which have reached the IV and V instars and show promise of developing into normal 6 or 7 striped adults.

VII.—THE LENGTH OF THE INCUBATION PERIOD UNDER SEMI-NATURAL CONDITIONS.

The shortest period of incubation so far observed under these conditions was recorded this year, *viz.* 12 days.

The details are given in Statement K.

PART III.

STUDIES OF OLD RECORDS: MISCELLANEOUS ITEMS: CONCLUSIONS.

I.—LOCUST MOVEMENTS IN THE YEAR.

Four reports were received during the year, but all of them were found to concerned with various species of Acrididæ. No swarms were reported observed anywhere during 1936.

1. *9th to 11th June 1936.*—Report to the Imperial Council of Agricultural Research from the N.-W. F. Province. Hoppers were reported to have appeared in villages in the Peshawar Tahsil. On investigation by the Provincial Entomologist of the Frontier Province, the hoppers concerned were found to be those of *Thissotetrus*, *Celopteronops*, and *Calanrops* spp.

2. 31st August, 1936.—Report to the Imperial Council of Agricultural Research. Grass-hopper swarm attacking Fodder Juar in the Anarad village of Dhar State. Specimens sent proved to be *Hieroglyphus nigro-repletus* Bol.
3. 17th July 1936 Specimens of a swarming Acridid—*Aularches militaris* L. reported attacking thatchbaries in Kumargram Tea Estate, Jalpaiguri, Assam; from the Chief Scientific Officer, Indian Tea Association, Connemara.
4. 20th October 1936 Grasshoppers attacking the cotton crop and gram sprouts in Mayer Tahsil of Kushinagarh Chiefship. Proved to be species of *Acrotylus*, *Oedileus* and *Caloptenopsis*.

II.—STUDY OF OLD RECORDS.

During the year under report, most of the chronologically arranged data for the years 1926 to 1930 were gone through and edited for final typing. Data for the years 1926, 1928 and 1929 have been typed and are ready for being forwarded to the Imperial Council for printing, as suggested at the last meeting of the Locust Committee. The records for 1927, 1930 and 1931 will be taken up shortly.

The maps so far done were examined and compared as far as possible. Six-monthly maps for the years 1926 to 1930 were also prepared.

III.—CORRELATION OF METEOROLOGICAL DATA.

Indian Daily Weather Reports for the years 1926 to 1931, and 1932 to 1935 were taken on loan, in batches, from the Meteorologist, Karachi, and studied in correlation with the development of the locust situation in those years. The main points under study were the following: 1. The development and progress of summer and winter rainfall in each particular year for correlating the known facts of locust infestation and breeding; 2. Data in regard to the development of zones of high temperatures and low humidity in the winter-rainfall areas in early summer, and in the monsoon areas in autumn in relation with the recorded direction of swarm migrations during the cycle of 1926-1931; and 3. The correlation of the direction of swarm flights with the recorded direction of wind.

The results of the correlation of the wind directions have been particularly interesting. Though cases of differences of directions have been noted, there has been, on the whole, a remarkable preponderance of coincidences of directions. As far as possible, attempts have been made to show the direction of winds on the monthly maps for the different years. In one case, especially, the coincidence was rather very striking. While in the first part of June 1930, the flight of locusts was towards the east and the wind directions were also in general west to east in the United Provinces, the directions of the swarms as well as the winds had changed in the latter half of June 1930, with the development of the monsoon current, from east to west, so that by July 1930, the eastern parts of the United Provinces were clear of locusts.

During the last locust cycle, it is seen that in the years 1928 and 1930, west-bound flights were not noticeable in Baluchistan in the autumn months, while during the years 1926, 1927, 1929 and 1931 they were clearly well developed. A study of the situation in the months of September, October and November in regard to the meteorological conditions in the Rajputana area was made in these years, and the results obtained indicate that the absence of the west-bound flights in 1928 and 1930, was very probably due to the delay in the development of the north-easterly winds in the autumn, so that most of the swarms produced had departed from Rajputana in other directions. Table A has been prepared to show the situation in the western and eastern areas of infestation during 1926-1931 in regard to the development of zones of saturation deficiency.

TABLE A.

Development of areas of High Saturation Deficiency in regions subject to Locust infestation during 1926-1931.

Western zone in May-July.	Eastern zone in September-October and November.
<p><i>V.VII-1926</i>—Development of high temperatures and low humidity occurred in the areas of Dalbandin, Mirjawa and Panggur, (there being 3 peaks).</p> <p>(1) 20-27 V, (2) 13-19 VI and (3) VII. (95-109°; (101°-113°; (102-117, 13-60%) 5-60%) 12-60%).</p>	<p>1926.</p> <p><i>September</i> was fairly humid and cool.</p> <p><i>October</i>.—The dry zone developed and N., N. E. and E. winds prevailed at the beginning and the middle of the month.</p> <p><i>November</i>.—Low humidity—generally E. winds prevailed. As swarms developed mostly in October and November, migration westward also resulted.</p>
<p><i>V.VII-1927</i>.—(Two peaks)</p> <p>(1) 20-27 V (2) 23-30 VI and (98°-110°; 5-45%) 11. (99°-116° 3°-70%)</p>	<p>1927.</p> <p><i>Monsoon</i> continued till 1st week of October.</p> <p><i>September</i>.—Dry zone developed: 16-24 IX. Easterly winds began by the end of the month.</p> <p><i>October</i>.—Max: 92-99: Humidity about 35% to 60%.</p> <p>S. W. winds generally prevailed.</p> <p><i>November</i>.—Humidity low: E. winds prevailed towards the middle and end of month. (Unfavourable for westbound flights)</p>
<p><i>V.VII-1928</i>.—(3 peaks)</p> <p>(1) 22-31 V (2) whole of VI (102°-111°; (100°-114°; 16-50%) 8°-60%) and (3) whole of VII (94°-113°, 12-70%).</p>	<p>1928.</p> <p><i>Monsoon</i> continued into October.</p> <p><i>September</i>.—Fairly cool and moist: mostly S. W. winds.</p> <p><i>October</i>.—Dry zones developed during the first half of month, but the winds were mostly S. W.</p> <p><i>November</i>.—Low humidity prevailed: Easterly winds from 12th November onwards. (Conditions unfavourable till November 12th for westward flights.)</p>

Western zone in May—July.	Eastern zone in September-October and November.
<p><i>V-VII—1929.</i>—(Three peaks) (1) 19—31 V (2) whole of VI (90°—111°; (100°—115°; 16—50%) 0%—66%) and (3) whole of VII (97°—114°; 8—50%).</p>	<p><i>1929.</i> <i>Monsoon strong.</i> <i>September.</i>—Dry zone developed from 16th September but mostly S. W. winds prevailed. <i>October.</i>—Humidity generally low. N. E. winds prevailed on 4—5 X and from 16th October for a few days off and on. <i>November.</i>—Humidity low as also maxima: N. E. winds generally prevailed. (Breeding being at its maximum, both west bound and east bound flights took place.)</p>
<p><i>V-VII—1930</i> (4 peaks) (1) 6—11 V (2) 27—30 V (90°—114°; (95°—105°; 16—60%) 20—17%) (3) 5—30 VI and (1) whole of July (97°—114°; (98°—116°; 13—75%) 8—70%).</p>	<p><i>1930.</i> <i>Monsoon withdrew early about III week of September, breeding also early.</i> <i>September.</i>—Dry zone developed early; 107° max., and humidity 43%. But winds mostly S.W. or W.S.W. <i>October.</i>—Dry zone prevailed with high maximum temperatures; E. winds started only from 20 X and continued till 30 X. <i>November.</i>—Humidity low. East winds prevailed. (Breeding was early and most of the swarms appear to have departed eastward already.)</p>
<p><i>V-VII 1931.</i>—(3 peaks) (1) 17—21 V (2) 7—20 VI and (97°—108°; (95°—114°; 17—75%) 8—56%) (3) whole of VII (96°—108°; 9—60%).</p>	<p><i>1931.</i> <i>Monsoon withdrew only about 17th October.</i> <i>September.</i>—Dry zone developed from 18th September E. winds from 26th September. <i>October and November.</i>—Maxima lower; E. winds prevailed generally. (Westward migration occurred though late.)</p>

IV.—PUBLICATIONS.

A paper on "The Locust Incursion of 1935 in North-West India—Its Significance in the Study of the Locust Problem in India" was sent by me to the Journal of Agricultural Science and was published in the October 1936 issue. Two papers were, under instructions, submitted in March to the IV International Locust Conference at Cairo, viz., 1. "Migration among the Solitaires" and 2. The occurrence of Incipient swarming in Mekran". A note by Dr. M. L. Roonwal on "The Existence of two different types of striped eyes among solitary type individuals of the Desert Locust, *Schistocerca gregaria*, Forsk." was published in July 1936 in "Current Science", Volume V, page 24.

Two Bulletins on the Desert Locust by S. A. Predtechensky published in 1935 in Russian were kindly sent by Dr. B. P. Uvarov at the close of 1935, and arrangements were made to have them translated. One of them, viz.,

generation, the tendency is to produce the higher ratios and six-striped forms. In case there is a general correspondence between the number of stripes and the number of moults passed through by the hoppers, the eye-stripe character would become a valuable index in judging about the likelihood of swarming in any given area, since the number of moults would be fewer when rapid multiplication takes place.

In regard to the presence of stripes in other species, it is interesting to note that the number of stripes is either 7 or 8, in the specimens of *Patanga succincta* in the Karachi collection, 8-striped forms being, however, more common. In the single specimen of *Nomadacris septemfasciata* kindly presented by Dr. Uvarov, for the Karachi collection, the number of stripes is 7. It is rather significant to note that both *Patanga* and *Nomadacris* are known to pass through at least six moults as a rule. Specimens of *Anacridium* in the collection have either 7 or 8 stripes, as also those of *Cyrtacanthacris tatarica*. As already mentioned, about 6 specimens of 8-striped forms of *Schistocerca* have also been met with in nature this year.

VII.—MISCELLANEOUS ITEMS.

1. *Pasni Buildings*.—The buildings were completed at the beginning of the year, and occupied by the staff.

2. *Large Field Cages*.—Only four of the cages were in use during the year but their usefulness was greatly affected by the inroads of ants. Again, owing to the high humidity and the heavy winds prevalent throughout the year, and the formation of thick fogs and mists, and the accumulation of fine clay dust among the meshes, the copper wire gauze used for the sides of the cages has already perished in many places, and may require replacement.

3. *Distinguished Visitors*.—The office at Karachi had the honour of a visit on the 1st September 1936 by Sir Bryce Burt, Kt., C.I.E., M.B.E., I.A.S., Vice-Chairman, Imperial Council of Agricultural Research.

On the 2nd December 1936, Sir John Russell, O.B.E., D.Sc., F.R.S., Expert Scientific Adviser (Crops) to the Imperial Council of Agricultural Research accompanied by Lady Russell, Mr. R. L. Sethi, Secretary-Adviser, Rao Sahib K. I. Thadani, Offg. Chief Agricultural Officer in Sind, and myself paid a visit to the Ambagh Locust Research Station, in Lasbela State. On the 3rd December, Sir John Russell paid a visit to the office at Karachi for discussing the locust work.

4. *Supply of locust specimens for experimental work at Lyallpore*.—At the request of the Government Entomologist, Punjab, locusts collected from Ambagh were supplied in May, and in September specimens of locusts and hoppers collected from nature in the Bikaner areas were handed over to a Fieldman. In October, a third consignment collected from nature at Ambagh was supplied.

5. *Information regarding the Iranian and Persian Areas*.—As decided at the Locust Committee, a questionnaire in regard to the information required concerning locusts and locust breeding in the areas of Iranian Mekran, and the Arabian Coasts of the Persian Gulf, was prepared and submitted to the Imperial Council of Agricultural Research, for circulating to the authorities concerned.

VIII.—ACKNOWLEDGMENTS.

Ready and whole-hearted help kindly rendered to the Locust Survey Staff during their tours in connection with locust research work by the various authorities in Sind, Baluchistan, Rajputana, the Punjab States and the Punjab, and by the Durbars of Kalat, Las Bela, Bikaner, Jodhpur, Jaisalmer, Bahawalpore and Khairpur States is hereby thankfully acknowledged. The thanks of the Imperial Council of Agricultural Research are specially due to the Durbars of Kalat, Las Bela, Bikaner, Jodhpur and Jaisalmer for facilities provided to the staff at the Locust Research Stations opened in their territories. I take this opportunity of thanking Mr. V. V. Sohoni, B.A., M.Sc., Meteorologist, Karachi for the various facilities and help provided to me in the study of meteorological data in relation to locust work. My thanks are specially due to Dr. L. A. Ramdas, M.A., Ph.D., Agricultural Meteorologist, Poona for help and advice in regard to the purchase of various meteorological instruments. I wish to place on record my indebtedness to Sir Guy A. K. Marshall, C.M.G., F.R.S., Director, Imperial Institute of Entomology and Dr. B. P. Uvarov, D.Sc., for kindly identifying various insect specimens and for other help rendered. My thanks are due to the Curator, Royal Botanical Garden, Sibpur for kindly naming several lots of plant specimens.

I have to place on record the good work done by Mr. Chandar Parkash, B.Com., till recently Senior Compiling Assistant at Karachi, who was appointed at the Imperial Institute of Sugar Technology, Cawnpore at the beginning of October. He was of very great help to me in extracting information from various records, mapping the locust movements, and studying various meteorological data. The loss of his services and his experience has been a great handicap this year. The section also lost the services of three efficient hands in the clerical line by the transfers of Messrs. R. L. Mehta, Shafkatullah, and Abdul Halim (Clerk at Pasni since 1932). I wish to express my thankfulness to Dr. Roonwal, Dr. Mukerji, and Messrs. Bhatia, Batra, Taqi Ahsan and Rashid Ahmad for enthusiastically carrying out their work through out the year.

IX.—CONCLUSIONS FROM THIS YEAR'S RESULTS.

In comparison with last year's happenings, the year under report has proved somewhat uneventful in regard to locust developments. On account of the lower rainfall this year on the Mekran Coast of British Baluchistan, and even in the Iranian areas, except at Bushire, the breeding was very much restricted. Nor was any breeding of any consequence noticed in the interior of Mekran. In spite of the low rainfall, however, there were evidences of secondary breeding in the hinterland. In Kolwa, a development of gregarious hoppers was reported even during the first generation, and in June-July a small breeding representative of the second generation of the season was noticed near Panjgur.

Secondly, the present year's observations have confirmed last year's findings in regard to the occurrence of a migration of the solitary locusts. Arrival of migrant locusts was noticed in early summer almost at the same time at Pasni, Ormara, Ambagh, and Chachro. Evidence of a return migration in the autumn months was also obtained at Ambagh, Ormara and Pasni.

Experiments with the marking and liberation of locusts has not so far given any definite results, but that would appear to be due to our ignorance as to where we should expect the liberated locusts to go to. There appears to be little doubt that locusts would be carried by the prevailing winds, and that they cannot be expected to fly against any wind of some force. The locusts that were noticed at the end of May this year almost simultaneously at Pasil, Ormara and Ambagh could not have taken a direct west-to-east direction. It is more probable that they had been carried from the coastal areas into the Mekran interior by the S. W. wind and had later on been deflected south by the unsuitably dry climate of the interior.

Possibly, the earliest locusts usually arrive in the Desert area with the S. W. wind in the region of Khairpur, Bahawalpore and north Jaisalmer, and reach the southern areas of Marwar and Thar-Parkar only later on with the development of winds from the N. W. or from the N. E. at the time of the appearance of depressions in the Rajputana area. On this account it appears to be important to keep watch over the areas of Kachhi, N. Sind, Khairpur and Bahawalpore at the beginning of the migration season in May-June.

Thirdly, on account of the heavy rainfall in the Bikaner Jaisalmer area this year the breeding in the desert has been fairly early and heavy, though in the south in S. Marwar and Thar areas, the breeding has not been extensive. In the northern areas, the development of two successive generations has been noticed. During November and early December, quite large numbers of locusts have been noticed in the north Jaisalmer, Bikaner and Bahawalpore areas, which do not seem to be likely to migrate now, owing to the onset of the winter conditions, when there is usually no urge from climatic considerations to quit the desert area. It is necessary therefore to watch their further movements, to see whether they will move west or east in spring. On account of the limited nature of the survey staff, it has not been possible to find how far east the solitaires would penetrate.

The study of the meteorological data and their correlation with locust data has been productive of much useful information, and the fact of the coincidences of wind directions is a very important advance in our knowledge.

The discovery of the eye-stripes should also be considered an important advance as it may lead to important inferences if worked up more fully.

The food-experiments also appear worthy of being followed up.

PART IV.

SUGGESTIONS FOR FURTHER WORK.

At the last meeting of the Locust Committee, it was decided that Locust observation work and a locust warning organization should be continued on a permanent or semi-permanent scale under the Government of India, and in case any permanent arrangements have been made, the future of the work might best be settled by the Imperial Agricultural Department. Suggestions made here are on the basis of a continuation of the present organization, and might therefore be modified as needed.

My recommendations are that the work might be continued on the same scale with more or less the same staff, with the following few additions.

M253ICAR

1. *Pasni*.—One of the Messengers was transferred to Patnāgur when that Outpost was created, and on account of the increase of biological experiments at Pasni, it is desired that a messenger on Rs. 12 might be added to the staff.

2. *Karachi*.—Last year it was suggested that food experiments with the Sind-Rajputana desert plants might be conducted at Karachi. I should bring it to the notice of the Imperial Council that at the place where the office is located, there are few facilities for growing the desert plants and conducting the experiments. Shifting the office to a better locality with facilities for growing plants would mean renting a suitable building, which would lead to further expense. I should, therefore, suggest that they might be performed either at Ambagh or Chachro, where the plants might either be grown or perhaps be secured from the surrounding desert.

3. *Sind-Rajputana Area*.—As already stated, the Khairpur-Bahawalpore-Kachhi area is important as the earliest migrants—whether as swarms or individuals—are likely to be met with here. Last year, one of the Fieldmen was posted at Khairpur with the Imperial Council's permission for six months. As this arrangement disturbed the work at Barmer, I should suggest that a Fieldman and a messenger be added for being posted at Khairpur throughout the year.

4. In case the transfer of the present organization under the Imperial Department be completed, my services would no longer be needed for guiding the work, but since there is yet a great amount of work to do in regard to the working up of the results of the last 6 years for purposes of publication, and also with reference to the completion of the biometric and compilation work, I should request that my services may be continued for the next year for this purpose.

KARACHI;

Dated the 27th December 1936.

Y. RAM CHANDRA RAO,

Locust Research Entomologist, Karachi.

A NOTE ON THE RESULTS OF THE WORK DONE UNDER THE LOCUST RESEARCH SCHEME OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH DURING THE YEARS 1931 TO 1936.

THE AIMS OF THE LOCUST RESEARCH SCHEME.

The aims of the Locust Research Scheme as initiated in 1930 may be considered under the following heads :—

1. Studies on the Bionomics of the Desert Locust;
2. Experiments on the Control methods;
3. A survey of the permanent breeding grounds within the limits of India;
4. An ecological study of the solitary phase in its breeding grounds; a study of the fauna and flora in these areas, including an investigation of the natural enemies of the locust as well as its food-plants;
5. A study of the migration routes of the Locust in the Indian area;
6. A correlation of the meteorological factors; and
7. A study of the past invasions.

The first of these items has been under study at the Locust Laboratory at Lyallpore, and the second could not be taken up as the swarms disappeared after 1931. The rest of the items have been under study by the staff under a unit, first stationed at Quetta and, since June 1933, at Karachi.

The results so far obtained during the last six years under the different items are attempted to be set forth briefly in this note.

I.—SURVEY OF THE PERMANENT BREEDING GROUNDS WITHIN INDIAN LIMITS.

Surveys of the Baluchistan areas were first taken up in 1931, resulting in the detection of the "Rek" breeding grounds along the coastal areas of southern Baluchistan. This led to the establishment of a Locust Research station at Pasni in January 1932, in the midst of one of the "Rek" areas. The preliminary surveys of Sind and Rajputana were attended to during 1932. From June 1933, closer attention was devoted to intensive surveys of particular areas with the aim of having continuous observations of the activities of the 'solitaria' locusts during the different seasons of the year. From June 1934, intensive observations were started at certain outposts opened in parts of the Indian Desert areas and in parts of southern Baluchistan.

During the current year—1936—intensive survey work was in progress at Nokh, Sardarshahr and Chachro in the Desert areas, at Ambagh in the Lasbela State, and at Pasni, Gwadar, Turbat and Panjgur in the Mekran area.

The results obtained in the course of the work may be briefly summarised as follows.

1. The surveys have made it clear that the area of habitation of the *solitary* phase of the Locust (in other words, its permanent breeding grounds), extends over a very large area, made up of (1) partly the "rek" or sandy

Coastal areas along the Arabian Sea and partly the interior of Mekran, and (2) the major part of the areas of the Great Indian Desert. On the whole, the region of 'habitat' of the Desert Locust is mainly of a sandy nature.

During the last 5 years, the locust has been found to be present in the above areas in greater or smaller numbers and to breed there regularly in the event of rainfall.

2. Breeding of the solitary locust would appear to be absolutely dependent on the fall of rain sufficient to wet the sandy soil at least to a depth of one foot. Wherever the sand has become consolidated into fairly firm soil, the soil moisture evaporates rather quickly, and locusts cannot lay eggs, after the lapse of about 3 to 4 weeks, in such soils; on the other hand, wherever the surface layers are of wind-blown sand, they tend to conserve the moisture in the deeper layers for a longer time. The length of the period of breeding would, thus, depend on the nature of the soil and on the occurrence of frequent showers.

3. The experience of the last five years has shown that good rainfall will lead to extensive breeding on 'rek' or desert areas and bring about a considerable increase in the locust population. The latter, however, has not so far brought about a concentration of numbers or led to the transformation of the phase *solitaria* into phase *gregaria*. On the other hand, such a concentration followed by transformation was noted to occur in 1935, in certain isolated sandy areas in the interior valleys of Mekran, large numbers of hoppers having been found in a crowded condition in small patches of cultivation, probably as a result of concentrated egg-laying by migrant locusts from the coastal areas. The hoppers may be taken to represent, in great part, the second generation of the season. Such spots may be deemed to function as "outbreak centres" and to serve as points of origination of the swarms. A study of the past records of the Mekran area has shown that such "outbreak" centres had come into existence in the past in parts of the Kulanch valley in 1926 and parts of the Dasht valley in 1923.

Since the areas of Iranian Mekran are more or less similar in general character to those of the adjacent provinces of British Mekran, it may be presumed that such 'outbreak centres' had also developed in the Iranian area at the time of the great locust incursion noted in 1935, and probably also during the year 1926.

Such 'outbreak centres' have not so far been met with in the Rajputana area, but perhaps they may be expected to occur there during years of extraordinary multiplication.

4. *Occurrence of migration among the solitary locusts.*—One of the items of study undertaken at the Locust Field Research Station at Pasni and elsewhere has been the determination of the relative density of locust population at different parts of the year. As a result of continuous observations made from 1932 to 1936, it has been found that the locust population at any particular place is subject to great fluctuation in the course of a year. Local breeding occurred whenever there was rainfall and led to a definite rise in the population. But in certain cases, it was observed that an increment in the numbers occurred in spite of the absence of breeding, and in such cases it was also

noted that there was a change in the biometrical characteristics as well as the general colouration of the locust population. At other times, a perceptible decrease in the numbers was noticeable, which could not be ascribed to the activities of natural enemies.

During the year 1935, however, at the time of the occurrence of an incursion of locusts of a considerable magnitude in various parts of N. W. India, definite evidence was obtained as to the capability of even the *solitary* (or rather the non-gregarious) locusts to migrate long distances by flight. In fact, they would appear to have migrated from Mekran into the Rajputana areas in summer and to have bred there during the monsoon rains, and the new generation produced in the desert areas would appear to have reached the coastal 'rek' areas of Mekran in October, November and December 1935. Observations continued during the current year have served to confirm the existence of migration as a general phenomenon, —from west to east in early summer and east to west in autumn and early winter.

Various anomalies of distribution had been noted during the Locust surveys made during the years 1932 to 1934, which had been found difficult to account for at the time, but on the basis of the facts of migration among the solitaires that have since come to our knowledge, those data can now be easily explained.

Since the solitary locusts are now known to breed in the 'rek' areas during the spring and migrate to the desert breeding grounds for breeding during the summer rains, the 'rek' areas of Mekran and the areas of the Sind Rajputana Desert can no longer be considered to be distantly situated, separate breeding grounds, but rather to be complementary to one another.

In the course of a biometrical study of the collections of locusts made during the years 1931 to 1936, it has been noticed that there is a rough correspondence in the character of the locust population, as judged by the proportion of the different Elytron/Femur ratios and the relative dominance of 6 or 7 eye-stripes, between the forms found in winter or spring in Mekran and of those found in the preceding autumn in Sind-Rajputana, and between the forms produced in Mekran in spring and early summer and those found at the beginning of the monsoon in the Rajputana deserts.

5. In the course of the survey work, a good representative collection of the Acrididae of the desert regions has been made, most of which has been identified by the Imperial Institute of Entomology, London. A collection of various birds, lizards and other animals affecting the life-economy of the locust has also been made and studied as far as possible.

An exhaustive collection of various plants found in the desert areas of Sind, Baluchistan and Rajputana has been made in the course of survey work, and has been examined and worked out by the Curator of the Herbarium, Royal Botanic Gardens, Sibpur. As far as possible, the local names under which each plant is known in different linguistic areas have been collected, and a list of the plants has been prepared for publication.

Wherever possible, observations have been made in regard to the plants preferred by locusts and hoppers of the solitary phase.

II.—ECOLOGICAL STUDIES OF THE SOLITARY PHASE.

1. *Meteorological Observations.*—The following observations have been under record at Pasni since 1932 :—

- (a) Stevenson Screen—
 - Atmospheric temperature—
 - Maximum and Minimum.
 - Relative Humidity—
 - Maximum and Minimum and at 8 A.M. and 5 P.M.
- (b) Black Bulb and Grass minimum temperature at 2" above soil surface from July 1936.
- (c) Open air temperature.
- (d) Bush temperature and Bush humidity (maximum and minimum)
- (e) Soil Temperature—
 - 1. Surface maximum and minimum.
 - 2. 2-inch depth maximum and minimum.
 - 3. 4-inch depth maximum and minimum.
- (f) Soil moisture : at 2-inch depth and at 4-inch depth once a week and after rainfall.
- (g) Evaporation : Piche Evaporimeter : (a) in shade, (b) in sun.
- (h) Sun-shine Recorder : (since July 1936).
- (i) Wind : Direction : Velocity and mileage per day by Anemometer.
- (j) Barometric Pressure with an Aneroid Barometer.
- (k) Rainfall.
- (l) Depth of penetration of rain into sandy soil.
- (m) Occurrence of fogs and dews and their penetration into the sandy soil.
- (n) Clouds and other phenomena.

A thermo-hygrograph has recently been added to the equipment at Pasni.

Many of the above data have been under record at Ambagh since 1933, the observations being representative of 'reks' of the eastern type coming under the influence of summer or monsoon rainfall.

Since June 1934, simple observations of atmospheric temperature and humidity in screen, rainfall, etc., have been recorded at the Desert Out-posts of Nokh, Sardarshahr and Chachro.

The various observations recorded have been found of great use in studying the response of the locust to changes in the climatic conditions in the different areas.

2. *Field Observations.*—During the periodical surveys made in the breeding grounds, locusts found in nature were kept under close observation to note how they were affected by changes in their general environment.

From observations made during the last 6 years (*vide* Table I), the factor that was found to have the greatest influence on their life-economy was *rain-fall*. Breeding occurred only when there was rainfall sufficient to bring about a fairly deep penetration of moisture in sandy soils. In cases where locusts were already fairly mature at the time of the occurrence of rain, eggs were laid almost immediately, while in other cases sex-maturation was apparently hastened thereby.

As observed under semi-natural conditions, in the case of locusts in breeding cages kept in the open, the rate of development of the embryos and of the growth of the hoppers quickened with the rise of temperature. The shortest period of embryonal development as observed in cages under semi-natural conditions during the last four years at Pasni was $12\frac{1}{2}$ days in mid-summer, and the longest was about 73 days during the winter period. The shortest duration of the hopper period recorded under such semi-natural conditions was 31 days during summer.

As to the number of generations passed through in a year, it was found that, under normal conditions, there was only one brood during the year on the Pasni 'Reks'. In a year of rather protracted and heavy rainfall, as in 1933, when there were two heavy falls, the first in February and the second in April, two generations were noted to follow each other rapidly. At Pasni, breeding occurs usually only during the rains of the winter period, but summer breeding may also occur whenever there is considerable summer precipitation, as had happened in 1930 and 1932. There was only summer breeding in 1932, while in 1930 there was, presumably, both spring and summer breeding.

In the Rajputana area, two successive generations have been noted during years of well-distributed monsoon rainfall, as had, for instance, happened recently in the Bikaner area (1936).

In order to determine the number of generations that the locust might pass through during a year on the 'rek' areas of Pasni, provided the locust were given the necessary conditions favourable for egg-laying and development such as moist soil and fresh food, successive broods were under observation, during the last 4 years, in cages kept under semi-natural conditions in the open, and it was found that four successive generations could be produced within a period of 13 to 14 months. That such continuous breeding can actually take place under natural conditions at Pasni has been demonstrated by the records of the occurrence of freshly hatched hoppers of the locust for over 9 months in the year, in certain special areas of the Pasni 'Reks', during years of plentiful rainfall as in 1933 and 1935.

During every period of breeding, field observations have been made in all the areas of occurrence, as to the earliest time of appearance of first stage hoppers and of freshly fledged adults, and also as to the latest time of persistence of hoppers.

3. *Food Preference*.—Observations made in the field have shown that the hoppers of the *solitary* phase have definite preferences for certain food-plants, though in the event of their non-availability they may take to other food-plants usually not much liked. On the Western 'Reks' of Mokran, *Marrand*

(*Heliotropium undulatum*) is the plant most preferred, but in its absence, 'Balibar' (*Aerva javanica*), and 'Kullichk' (*Cyperus arenarius*) are taken. In the Eastern 'Reks' in the Lasbela area, 'Marrand' is scarce, and the plant most preferred is 'Kharzan' (*Sericostoma pauciflorum*), and next in the order of preference were *Aerva javanica* and certain grasses. In the Sind-Rajputana area, the plants most liked were *Indigofera cordifolia*, *Aerva javanica* (locally known as 'Booh'), *Tribulus terrestris*, *Cyperus* sp.; young 'Bharut' grass (*Cenchrus catharticus*), and 'Vishani' (*Tephrosia* sp.).

Experiments on Food-preferences were carried out to a certain extent in 1932 at Pasni by Dr. K. R. Karandikar, and in 1936 by Dr. M. L. Roonwal at Pasni and Mr. D. R. Bhatia at Chachro. An account of these will be included in the Annual Report for 1936.

4. *Effect of the quality of food on Sex-maturation.*—Experiments have been in progress at Pasni since 1935, and at Ambagh since May 1936 to test the effect of food on the sex-maturation of the Locust. They have shown that fresh, succulent shoots of a food-plant have a definite stimulatory effect in hastening sex-maturity, as compared with the leaves of over-mature old branches, and also that certain plants, such as tender Jowar, and tender Maize, 'Marrand' (*Heliotropium undulatum*), and 'Kullichk' (*Cyperus arenarius*) are able to bring about sex-maturity much earlier than others. At Ambagh, 'Kharzan' (*Sericostoma*) and 'Booh' (*Aerva*) appeared to give much better results than at Pasni.

The results in regard to Jowar and Maize may perhaps be of particular significance, since almost all cases of incipient outbreaks (the 'outbreak centres') were associated with patches of cultivation, especially of Jowari.

5. *Rhythm of Locust Activity.*—A fair amount of attention was paid during 1933, 1934 and 1935 at Pasni in regard to observations on this subject. A note on the observations made so far was prepared by Dr. Roonwal and was included in the Annual Report for 1935.

6. In the course of the various experiments in progress at Pasni, records of the duration of the different stages at different seasons, the sex-ratios of the hatchings, the colour of the hatchings, the length of life of adults, the number of egg-masses laid by individual females, etc., were made. During 1936, a considerable amount of work was done on the development of the eye-stripes among the hoppers.

III.—BIOMETRICAL STUDY OF COLLECTIONS OF LOCUSTS.

Collections of locusts made, since 1931, by the locust survey staff have been to a large extent examined, and notes have been taken for each individual locust examined in regard to (1) the Elytron/Femur ratio, (2) the number of eye-stripes, (3) the colour of the hind-wings, and (4) the general colouration.

1. *The Biometrical Ratios.*—In making a biometrical examination of specimens of *Schistocerca*, reliance has been placed mostly on the Elytron/Femur ratio, as it appeared to be most expressive of the phase characteristics of the Desert Locust. The other ratios employed in the case of *Locusta migratoria*, while useful in cases where femora have been lost, are not so expressive and are

rather difficult to work out accurately. Typical forms of '*gregaria*' collected from swarms found in 1931 have shown E/F ratios ranging from 2.18 to 2.30, while typical '*solitaria*' specimens developing from green hoppers on wild vegetation have shown ratios between 1.92 and 2.00. Ratios of an intermediate character have often been met with among locusts of non-gregarious character found in the desert, and since the transition from typical *gregaria* to typical *solitaria* is quite gradual and complete, an arbitrary limit has been, for the sake of convenience, placed at 2.05 for *solitaria* and at 2.16 for *gregaria*, to mark off the *intermediate* or *transiens* ratios, which would thus fall between 2.06 and 2.15 (both inclusive).

2. The Eye-stripes.—The discovery made by Mr. M. L. Roonwal in January 1936, of the existence of two types of eye-stripes in the Desert Locust has proved to be a very significant character in the study of locust populations. Specimens collected from swarms have invariably been found to be possessed of 6 stripes, while typical extreme '*solitaria*' bred in the deserts—especially the female ones, have mostly 7 stripes. The forms collected at the time of the great incursion of 1935 were found to have mostly six stripes, and the same was the case with the pink and yellow forms that migrated into the Pasni 'reks' in May 1932.

A study of the populations found at different parts of the year has shown that, as a rule more of the 6-striped forms are produced in spring and summer in Mekran, while more of the 7-striped ones are generated in the Sind-Rajputana deserts during the progress of the monsoon.

While the exact significance of the number of stripes is not yet clear, the available evidence may perhaps lead one to associate the number of the stripes with the number of moults passed through in the hopper stage.

3. Colour of the Hind-wings.—The colour of the hind-wings has been found to be of much help in determining the approximate age and state of development of the locust. Hyaline wings are characteristic of a recently fledged generation. A light yellow tinge is assumed in about a fortnight under normal conditions, and is generally expressive of the onset of adolescence, while a deep yellow would usually denote a state of full maturity. In certain cases, the whole of the hind-wing assumes a light pink colour, while in other cases, the colouration is restricted to a distinct patch of light or deep mauve, blue or pink at the base of the wings. This has been found to be characteristic of forms undertaking long migrations in sunny weather. The development of the pink, blue or mauve colour would appear to be due to the prolonged exposure of the hind-wings to the rays of the sun during active flight, and this assumption has been to a great extent confirmed by the results of certain experiments, wherein one of the elytra of locusts kept in cages in the open was cut away so as to keep the hind-wings of that side exposed to the sun's rays. In the case of many of these, pink, mauve or blue was found to appear in varying degrees of intensity on the exposed hind-wing.

4. The Body Colouration.—General observation has shown that, unless locusts happen to be in a state of migration, they tend as a rule to assimilate the general colouration of their surroundings. Forms found in the desert usually assume bright stripes, which serve to break the monotony of the ground-colour

of their body and assimilate it to the light and shade of the stems of grasses or other plants found on the soil. A good many of the solitary locusts found among thick green vegetation in Rajputana and Lasbela in July-August were found to have developed patches of fairly bright green on their body and elytra. At a later stage, when grasses had dried up, the prevalent general colouration of locusts was a hay-brown. Specimens found on stony soil were generally noted to possess a dark brown colour.

When the examination of all the available collection of locusts of past years is completed, it is anticipated that a study of the results would yield valuable information in regard to the details of locust developments in the near past.

IV.—STUDY OF OLD RECORDS.

During the last six years, all available records relating to locust activities in the past within the areas of Sind, Baluchistan, Rajputana and Bombay have been examined and extracts taken for study. As far as possible, rainfall data for various areas of N. W. India affected by locusts have also been collected for the past years.

The information thus accumulated has been studied as far as possible and the results may be considered under the following heads:—

(1) Locust activities within the Indian area during the last cycle of 1926-1931, (2) Correlations of Meteorological data with recorded locust movements during 1926-1931, and (3) Locust developments of years prior to 1926.

(I) *The Great Cycle of 1926-1931.*—All available information relating to this cycle for the areas of Sind, Rajputana, Baluchistan and Western India States has been classified chronologically and the data concerning the movements and activities of locust swarms have been mapped month by month, and as far as possible correlated with available meteorological data for these years. Data in regard to the other areas of North-West India, viz., Punjab, North-West Frontier, United Provinces and Central India have been studied by Khan Bahadur Afzal Hussain, I. A. S., formerly Locust Research Entomologist to the Imperial Council (1930—1933).

From the information gathered in regard to the areas of Sind, Baluchistan, Rajputana and Western India States, the following inferences may be made.

1. One of the centres from which the last great infestation of 1926-1931 originated would appear to have been the province of Mekran, the main factor that led to its development having been the heavy and widespread rainfall of January 1926 inducing extensive breeding of locusts on the coastal "rek" breeding grounds and leading to their subsequent concentration in certain 'outbreak' areas in the interior of Mekran, such as Kulanch. The subject has been dealt with in some detail in a paper published in the Indian Jl. of Agricultural Science, III—part 5, October 1933—"Mekran—Possibly the Country of Origin of the Great Locust Invasion of Sind in 1926".

2. The initial concentrations produced in June from the 'outbreak centres' in Kulanch—and probably also from similar sources further west in Iranian Mekran—had presumably migrated during June, July and August probably partly as small swarms and partly as individual locusts as had happened in 1935, into Sind and Rajputana deserts. The very favourable rainfall of 1926 monsoon had evidently served to induce rapid breeding and to bring about the formation of the huge swarms, which spread south, west and north in the autumn of 1926.
3. The western swarms probably penetrated far into Persia and formed the main source of the infestation recorded in the spring months in the Persian area in 1927.
4. During December 1926 and January 1927, swarms did not show much activity and probably over-wintered wherever they were overtaken by cold weather. Within Indian limits, the following areas, viz., the greater part of southern Baluchistan, parts of Sind, and south Punjab and the plain of Kachhi, evidently functioned as over-wintering areas. In February 1927, the swarms became active again and laid eggs wherever rain had fallen. There was considerable egg-laying in Mekran, and from March onwards the swarms began to move gradually north and north-east into the uplands of Baluchistan, ultimately reaching the farthest and highest valleys, such as those of Quetta-Pishin and Toba Achakzai, in May. Considerable egg-laying occurred in these regions.
5. Locusts of the new generation were ready to fly by May in the lower valleys and about a month later in the upland areas. The swarms gradually moved eastwards into Sind, Punjab and Rajputana by June-July. Breeding commenced in August after the fall of the monsoon rains in the desert areas of Thar-Parkar and Rajputana.
6. The adults of the new generation were ready to assume flight at the end of September and during October, and moved in general in a western direction into Baluchistan during November and December 1927.
7. Over-wintering occurred in parts of Sind and southern Baluchistan, as in 1926.
8. During the years 1928, 1929, 1930 and 1931, the activities of the swarms more or less resembled those of the year 1927. During the months—February to June, the swarms bred in the winter rainfall areas in Baluchistan, the volume of the breeding and the localities affected, in particular years, being determined by the amount and the distribution of rainfall in the different areas. During the months of May, June and July, a migration of the new generation of locusts took place from the places of breeding into Sind, Punjab and Rajputana. During the monsoon months, summer breeding occurred in these areas wherever good rainfall was recorded, and the swarms that resulted therefrom flew either *eastwards* into Central India, or *southwards* into the Kathiawar States, or *westwards* into Baluchistan.
9. Since the flights to the east or to the south *do not* lead the locusts into regions where further breeding is possible these are of little consequence. It is the west-bound flight, that take them to regions where further multiplication

can take place and thus help the infestation to continue from one year to another. The records show that westward movements did occur during the years 1926, 1927, 1929 and 1931, and that the west-bound flights were particularly strong in 1929, while in regard to the years 1928 and 1930, there have been no indications of westward movements.

10. The continuance of a locust infestation, once it starts, would appear to be dependent on the ability of the locust swarms to transfer themselves from areas of winter rainfall to those of summer rains, and *vice versa*, at the right time, so as to be able to pass through two generations during the year, and its decline is probably to be attributed to the failure of rains in one or other of the breeding areas and the consequent failure of breeding."

11. The decline of the last locust cycle is probably due to a combination of several unfavourable factors. In spite of heavy multiplication in the summer of 1930, there was an absence of west-bound flights in the autumn of 1930, so that the swarms found in Baluchistan in the spring of 1931 were of comparatively small dimensions, and the spring breeding of 1931 was, therefore, somewhat limited. Though the resulting pink swarms migrated into Sind, Punjab and Rajputana, in June-July, there was no breeding in Sind and Lashela, and except in the Rajputana area where heavy rainfall was followed by considerable breeding, there was little multiplication even in Punjab and United Provinces. Westward flights occurred in the autumn of 1931, but owing to a total failure of winter and spring rains in 1932 in Baluchistan, locusts could not breed, with the result that the infestation practically came to an end.

(II) *Correlation of Meteorological Data.*—Some attention was paid during 1935 and 1936 to the correlation of meteorological factors with the recorded data of locust activities during the last great locust cycle.

First among the problems relating to locust movements is the determination of the factors that impel large bodies of locusts bred in a particular rain-belt to fly large distances to reach a different region of rainfall for purposes of breeding. Apparently it would seem as if the swarms were migrating from a zone of low humidity in order to reach another of high moisture content, but it is somewhat difficult to imagine how locusts could orient their flights to reach a region of higher humidity situated hundreds of miles away.

While examining the various daily meteorological data recorded in the Indian Daily Weather Reports for different years relating to the areas of summer and winter rainfall where locusts usually breed, it was noticed that, at the close of the seasonal rains, there is often a sudden rise in temperature and a simultaneous fall in atmospheric humidity, generally accompanied by a change in the seasonal direction of the winds. Some of these areas usually develop into zones of high saturation deficiency, in which owing to the high soil surface temperatures and the low humidity, locusts apparently find it difficult to live. Such dry hot areas are found developing in low basins, such as those of Kharan and Chagai in western Baluchistan and those of Bampur and Seistan in Iran, from May onwards. Dry scorching winds generally from a north-west direction are, moreover, prevalent in these areas for nearly four months in the year. Along the coastal areas of Mekran and Sind, on the

contrary, the cool south-west breeze establishes itself from April onwards, and in May-June it strengthens in velocity and duration and penetrates far inland in eastern Baluchistan and north-west India. In their efforts to flee from the interior areas of intense aridity, the flying locusts, sooner or later, reach the S. W. current and would appear to be carried by stages into the interior of north-west India. The progress of their flights apparently comes to an end only when they come into contact with the conditions of high atmospheric and soil humidity brought about by the fall of monsoon rainfall.

Similarly, in the Rajputana desert areas, soon after the south-west monsoon withdraws about the end of September or in October a period of bright and cloudless days follows, bringing about a sudden rise in temperature and a fall of humidity, and causing the development of a zone of high saturation deficiency. Locusts would appear to take advantage of the prevailing winds at the time and flee from such conditions. If the south-west winds still persist, the locusts would be carried towards the east or the north-east, and if north-west winds prevail, they would reach Kathiawar, and if north-east winds, which normally characterise the autumn period in the desert area, develop, a westward movement would ensue. The development of west-bound flights or their absence in particular years would, thus, appear to depend on whether the usual change in the direction of winds from the south-west to the north-east sets in early or late in the autumn.

Secondly, a great deal of attention was paid during 1936 to the study of the correlations of the directions of recorded locust movements and the wind-directions noted in the Indian Daily Weather Reports. This work was, however, much handicapped by the fact that in a good many cases the time of occurrence of the flights is not known, while the wind-directions shown in the Weather Reports are referable to observations made at 8 A. M. As is well-known, the winds noted in the afternoons may often be totally different in direction from those noted in the mornings. Again, in many instances, there are no records of wind data for the places where locust flights had actually occurred, and the probable directions can be inferred only by studying the data for the nearest recording stations. Even making allowance for all these various handicaps, it has been generally found that the flight-directions are remarkably coincident with the wind-directions. Such a coincidence was specially noticeable in the case of certain flights recorded in June-July 1930 in the United Provinces. During May and the first half of June 1930, the movements were from west to east in accordance with the prevailing wind directions at the time and the swarms had by June actually penetrated into Bihar; but by the second fortnight of June, with the development of the monsoon current from the Bay of Bengal, the direction of flights was reversed and the eastern half of the United Provinces was clear of locusts by the end of July.

Thirdly, in general, the occurrence of heavy oviposition was almost always to be found to be correlated with heavy rainfall and an absence of breeding with the failure of seasonal rains.

(III) *Locust Invasions prior to 1926.*—A vast mass of data has been gathered from all available sources, mainly season reports published in the Gazettes of various provinces and various Diaries and periodical reports. The

data have been classified chronologically after extraction, and have been cursorily studied. They await detailed examination and mapping, and correlation with meteorological data.

Of the above, the data extracted from the Sind Official Gazette in regard to locust occurrence in Sind from 1872 onwards have already been carefully examined and correlated as far as possible with the available data for Sind, Rajputana and Baluchistan. A graph has been prepared, from which it would be seen that there have been in Sind, during the last 66 years, i.e., from 1869 to the present time, 4 main cycles of locust infestation lasting 6 to 18 years, with intervals lasting 4 to 7 years, and also that every year there had been flights of swarms from Baluchistan into Sind during May, June and July, while during the autumn the movements were in the reverse direction, i.e., from the desert areas in the east to the Baluchistan area to the west of Sind. With the valuable information collected in regard to the activities of locusts during the current non-locust period, it should be possible to reconstruct the past history of the previous invasions to a great extent.

Data available for the Punjab from 1869 to 1925 (kindly supplied by the Punjab Government Entomologists), and for Bombay from 1869 to 1931, and for Rajputana and Baluchistan from 1890 onwards, have been cursorily examined, but await a detailed study.

From the data extracted for Bombay, information regarding the past activities of the Bombay Locust (*Palanga succincta*) from 1870 to 1926 has become available for detailed study.

V.—SOME PRACTICAL ISSUES OF THE PRESENT WORK.

In regard to the practical issues arising from the research work now in progress, the following statements may be made.

1. With the present fuller knowledge of locust migrations, and the migration routes, it would be possible, in the event of another infestation developing, to prognosticate with a fair degree of accuracy where attacks of swarms might be expected, so as to enable the provinces concerned to be prepared for the invasion beforehand.

2. Since swarms developed in Iran, and possibly even in Central Asia, may be expected ultimately to reach India during summer, and since also those bred in Sind and Rajputana deserts can reach southern Iran during the autumn and winter months, the need of international co-operation for fighting the pest cannot be emphasized too strongly.

3. In regard to the primary breeding grounds and the 'outbreak centres', there is little doubt that a great many of them do occur within Iranian limits just as they occur in the Indian area. Since the solitary locusts also have been found to be able to migrate long distances, it is evident that there is an intimate connection between the India Desert areas and the coastal 'reks' of British Mekran and Southern Iran. If, with the object of arresting the initial infestations and thus of nipping the evil in the bud, it is proposed to tackle the 'outbreak centres', as they develop, the experience of 1935 would show that, for a successful achievement of that end, an intimate co-operation of effort is indispensable between India and Iran.

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Table showing the relation between amount of rainfall and Locust breeding.

Year.	Season.	Pastu.		Ambagh (Samsat).		Chachm.		Nolh.		Sarvagshahr.	
		Rainfall.	Breeding.	Rainfall.	Breeding.	Rainfall.	Breeding.	Rainfall.	Breeding.	Rainfall.	Breeding.
1931	Spring ..	3-62" in January, February and March.	Breeding occurred.	Not observed		..		..		..
	Summer ..	Nil	Nil	Nil	Nil	Not known		Not known		Not known.	
1932	Spring ..	Nil	Nil	Nil	Nil	Not known		Not known		Not known.	
	Summer ..	6-167/11-17-VII-32.	Good breeding noted.	Nil	Good breeding.	Do.		Do.		Do.	
1933	Spring ..	1-85" on 24-II-33.	Good breeding: 2 generations observed on Pashu rek.	Nil	Nil	Nil	Nil	Not known ²		Not known	
	Summer ..	4-75" on 3-IV-33. Nil.	Nil	VI 9-30" VIII 2-30" IX 1-70" 13 10"	Good breeding occurred.	Good rainfall.		Not known		Not known.	
1934	Spring ..	1-05" on 9-I-34, nil later on.	Nil	Nil	Nil	Nil	Nil	Not observed		Nil	
	Summer ..	0-50" on 25-VI.	Nil	VI 2-10" VII 1-10" VIII 0-97" 1-23"	Light and early breeding.	VI 2-10" VII 1-53" VIII 0-28"	Light and early breeding.	VI 1-30" VII 3-52" VIII 8-15"	Not observed.	VI 1-27" VII 0-90" VIII 6-58"	Light breeding.

Table showing the relation between amount of rainfall and Locust breeding—concl'd.

Year	Season.	Pasu.		Ambagh (Sonmiani)		Chachro		Nokh.		Sardarshahr	
		Rainfall	Brooding.	Rainfall	Brooding	Rainfall	Brooding.	Rainfall	Brooding	Rainfall	Brooding.
1935	Spring ..	XII 31 1-08" I-36 5 14" II-36 4-30"	Heavy and extensive breeding	Nd	Nd.	Nd	Nd	Nd	Nd	I 1-36" II 0-65" III 0 56"	No breeding
	Summer ..	11-48" Nd	Nd	Nd	Nd.	VII 8-18" VIII 2 17" IX 0 40"	Moderate breeding	VII 0 23" VIII Nd IX 0 68"	Nd	VI 1 09" VII 0 52" VIII 1 05" IX 3-39"	Light breed- ing
	Spring ..	I-36 1 52" II-36 1 20" III-36 0-82" Nd	Moderate breeding Nd	Nd	Nd.	Nd.	Nd	Nd	Nd	Nd	Nd.
1936	Summer ..			VI 0-36" VII-1 32"	L 1 f h t breeding. ,	VI 0-31" VII 4-64" VIII 0 06" IX 1-25"	Light and rather early breeding	VI 0-31" VII 0-80" VIII 10-70" IX 0 69"	Moderate but late breeding	VI 0 53" VII 0 03" VIII 2 71" IX 0 52"	Late and light breed- ing

*List of Statements accompanying Annual Report of the Locust Research
Entomologist, Karachi, for the year 1936.*

<i>Statements A.—List of Tours undertaken.</i>	<i>PAGES.</i>
A-I.—Sind-Rajputana areas. 	51—55
A-II.—Mekran Area. 	56—61
A-III.—Lasbela Area. 	62—63
<i>Statements B.—Details of Locust Findings in :</i>	
B-I.—Sind-Rajputana area. 	64—69
B-II.—Mekran Area. 	70
B-III.—Lasbela Area. 	71—73
<i>Statements C.—Results of Intensive Surveys.</i>	
C-I.—Pasni. 	74—76
C-II.—Gwadar. 	77—78
C-III.—Ambagh. 	79—80
C-IV.—Chachro. 	81—82
C-V.—Nokh. 	83—84
C-VI.—Sardarshahr. 	85—86
<i>Statement D.—Movements of the Locust Research Entomologist</i>	87
<i>Statements E.—Rainfall Data :</i>	
E-I.—1936 	88
E-II.—1935 	89
E-III.—1934 	90
E-IV.—Monsoon Rainfall in Desert areas. 	91
<i>Statements F.—Table of monthly data of Meteorological observations</i>	
F-I.—Pasni 	92
F-II.—Ambagh 	93—94
F-III.—Chachro 	95
F-IV.—Nokh 	96
F-V.—Sardarshahr 	97
M253ICAR	II

<i>Statements G.—Experiments on the Quality of Food on sex-maturity.</i>	<i>Pages.</i>
G-I. 1935—Summer Season—Pasni .. .	98—102
G-II. 1935-36—Autumn-Winter—Pasni .. .	103—106
G-III 1936—Summer Season—Pasni .. .	107—110
G-IV. 1935-36—Experiments at Ambagh .. .	111—112
G-V. Faecal matter excreted by adults—Pasni 1936 .. .	113—114
<i>Statements H.—</i>	
(1) Larva Feeding Experiments—Pasni. .. .	115—116
(2) Larva Feeding Experiments—Ambagh... ..	117—120
(3) Water contents of Foodplants .. .	121
<i>Statements I —</i>	
(a) Generation Experiments 1936 .. .	122—124
(b) Generation Experiments—1933-36 .. .	125—128
<i>Statement J.—Food Preference Experiments</i> .. .	129—132
<i>Statement K.—Incubation Period.</i> .. .	133—134
<i>Statement L —</i>	
(1) Effect of Sunlight on Colour of Wings .. .	135—137
(2) Effect of Sunlight on 'Gregaria' Eyes .. .	138
<i>Statement M.—Liberation of Marked Locusts</i> .. .	139—143
<i>Statement N.—Biometrical Analysis of Pasni Collection 1936</i> .. .	144—147
<i>Statement O.—Colour changes of Hoppers in painted boxes (Dr. Roonwal)...</i>	148—149
<i>Statements P.—Development of Stripes among Hoppers :—</i>	
(I) Dr. M. L. Roonwal .. .	150
(II) Dr. M. L. Roonwal .. .	151
(III) Dr. S. Mukerji .. .	152—153
<i>Statement Q.—Staff employed during the year 1936-37</i> .. .	154—156
<i>Statement R.—Statement showing the estimated total expenditure for the year 1936-1937</i> .. .	157—158
<i>Statement S.—Budget estimates of the office of the Locust Research Entomologist to the Imperial Council of Agricultural Research, Karachi, for the year 1937-38</i> .. .	159—161

STATEMENT A.-I.
Sind-Rajputana Area.

No.	Duration of Tour.	Personnel touring.	Districts visited.	Routes followed.
1	2nd to 18th December 1935.	Mulkraj, Fieldman	Bikaner, E. Jaisalmer, Jodhpur.	Sonpalpur, Lunkaransar, Kalasar, Pugal, Jodhasar, Barsilpur, Charanwala, Nokh, Phalodi, Barmer.
2	2nd to 18th December 1935.	Devki Nandan, Fieldman.	E. Jaisalmer, Bahawalpur, Jodhpur.	Chinnu, Rachandwala, Bijnot, Nawakot, Derawar, Ahmedpur East, Dera Nawab, Phalodi.
3	6th to 15th December 1935.	Girdhari Lal, Fieldman.	Tharparkar ..	Nawapura, Kantio, Chellar, Mehrar, Bhoreelo.
4	11th to 13th December 1935.	Asaram, Fieldman..	Sheo ..	Sheo.
5	16th to 20th December 1935.	Mr. D. R. Bhatia and Mulk Raj, Fieldman.	Mallani ..	Ramgar, Utarlai, Baitu.
6	17th to 24th December 1935.	Girdhari Lal, Fieldman.	Tharparkar, Mallani.	Chapur Khosa, Gadra Road, Barmer, Khisar.
7	11th to 19th January 1936.	Mr. D. R. Bhatia and Girdhari Lal Fieldman.	Tharparkar ..	Gadra Road, Khisar, Chachro, Chapur Khosa, Gadra Road.
8	18th to 30th January 1936	Narayan Behari, Fieldman.	Bikaner ..	Udrasar, Puntasar, Lunkaransar, Motasar, Rojri, Pugal, Bandrawala, Bikaner.
9	19th to 29th January 1936.	Girdhari Lal, Fieldman.	Tharparkar ..	Gadra, Kharri, Parna, Kantio, Chellar.
10	5th to 18th February 1936.	Mr. D. R. Bhatia ..	Jodhpur, E. Jaisalmer, Bikaner.	Phalodi, Nokh, Sardarshahr, Ratangarh, Bikaner.
11	12th to 28th February 1936.	Devki Nandan, Fieldman.	Jaisalmer, Jodhpur.	Awai, Tarana, Mohangarh, Basarpur, Sodhakhor, Chandisar, Sihar, Phalodi.
12	13th to 14th February 1936.	Mohd. Taj, Fieldman	Tharparkar ..	Gadra Road, Khisar, Chachro.
13	18th to 27th February 1936.	Girdhari Lal, Fieldman.	Tharparkar ..	Ilavat-jo-tar, Gundi, Rawatsar, Charnor.
14	22nd February to 6th March 1936.	Mr. Dr. R. Bhatia with Mulkraj upto Charnor later Girdhari Lal, Fieldman.	Mallani, Tharparkar.	Balera, Chohtan, Deduwar, Charnor, Chachro, Chapur Khosa, Gadra Road.

No	Duration of Tour.	Personnel touring	Districts visited	Routes followed.
15	29th February to 4th March 1936	Mulk Raj, Fieldman	Mallani	Rabwasar, Nilsar, Barmer
16	1st to 18th March 1936	Narayan Behari, Fieldman	Bikaner	Ranwasar, Jaitpur, Hardawal, Rawatsar, Nohar, Jabiasar, Rani, Khinwasar.
17	5th to 11th March 1936	Girdhari Lal, Fieldman.	Tharparkar	Gadra, Purna
18	13th to 23rd March 1936	Shanti Sarup, Fieldman	Jaisalmer	Charanwala, Barsilpur, Menkasar, Girasar
19	24th March to 9th April 1936	Peshawari Singh, Fieldman	Bikaner	Adesar, Punnasar, Jamsar, Kalasar, Motigarh, Pugal, Royri, Anupgarh
20 (a)	26th March to 4th April 1936	Dr. S. Mukerji, Mr. D. R. Bhatia, Girdhari Lal, Fieldman	Tharparkar	Gadra Road, Dalhi, Chachro, Kantio Umarkot, Chitor
20 (b)	3rd to 4th April 1936	Girdhari Lal, Fieldman	Tharparkar	Kantio, Bhoreelo, Chachro
21	5th to 25th April 1936.	Mohd. Taj, Fieldman	Tharparkar	Noopar-jo par, Khoitopar, Gadra, Chapur Khosa, Chachro
22	13th to 29th April 1936	Mr. D. R. Bhatia and Devki Nandan Fieldman.	Jodhpur, Jaisalmer	Phalodi, Nokh, Awai, Talana, Mohangarh, Hamira, Devkot, Barmer
23	4th May to 4th June 1936.	Mr. D. R. Bhatia with Devkinandan upto Bikaner and Narayan Behari after	Bahawalpur, Dera Ghazi Khan, Bikaner	Samasata, Dera Ghazi Khan, Bikaner, Kalasar, Pugal, Royri, Anupgarh, Nohar, Sahwa, Khinwasar, Sardarsahar.
24	6th to 25th June 1936.	Girdharilal, Fieldman	Tharparkar	Ciellar, Mithi, Pidorce Singalo, Diplo, Bhakno, Islamkot, Sinjoro Got, Chachro.
25	19th to 26th May 1936.	Devkinandan, Fieldman.	Jaisalmer	Phalodi, Sidan, Girasar, Nokh
26	2nd to 24th June 1936.	Mohd. Taj, Fieldman	Tharparkar, Mallani	Harat jo tur, Ghorabari, Gundi, Sarli, Dhorimana, Gura, Malpura, Sarawari Barmer, Baitu Gadra
27	2nd to 17th June 1936.	Peshawari Singh, Fieldman.	Bikaner	Sujanagarh, Sandwa, Jamsar, Surpara, Bikaner, Punnasar, Udrasar.

No	Duration of Tour.	Personnel touring.	Districts visited.	Routes followed
28	3rd to 27th June 1936.	Shanti Sarnu, Fieldman.	Jaisalmer, Jodhpur.	Choyan, Lathi, Mularo, Vinjorai Rama, Khudi, Pholia, Gura, Lakha, Shiv, Barmer, Phalodi.
29	12th to 20th June 1936.	Mulkraj, Fieldman	Khairpur ..	Kot Diji, Sorah, Thari, Akro, Bhiria Road
30	22nd June to 1st July 1936.	Mulkraj, Fieldman	Bahawalpur ..	Ahmadpur East, Dera-war, Chachran, Jajjah, Abbasian.
31	22nd to 28th June 1936.	Peshawari Singh, Fieldman.	Bikaner ..	Bhimsar, Bikarnsar, Adasar, Sardarshahr.
32	21th June to 4th July 1936.	L. R. E., Mr. D. R. Bhatia, Girdhari Lal, Fieldman.	Tharparkar ..	Gadra, Dalhi, Chachro, Chellar, Mithi, Nawakot.
32 (b)	3rd to 10th July 1936.	Girdhari Lal, Fieldman.	Tharparkar ..	Nawalot, Diplo, Bhakno, Islamkot, Sonalbo, Chachro.
33	1st to 25th July 1936.	Devkinandan, Fieldman.	Jaisalmer ..	Girasar, Mankasar, Barsilpur, Ranjitpur, Joluwala, Raluvwala, Bahla, Nihrahi, Ringarh, Bhadasar, Jaisalmer, Mohangarh, Thruna, Awas, Nokh.
34	1st to 22nd July 1936.	Peshawari Singh, Fieldman.	Bikaner ..	Soanpalsar, Lunkaransar, Rajasars, Motigarh, Pugal, Rojri, Anupgarh, Sarupsar, Raisingh Nagar, Sri Ganga Nagar, Nohar, Sihwa, Buchawas.
35	6th to 17th July 1936.	Mr. D. R. Bhatia, Mulkraj, Fieldman.	Kachhi (Kalat) Dadu (Sind).	Bellprit, Bhag, Shikarpur (Kachhi), Gandawa, Dadu (Kachhi), Nuttal, Dadu (Sind), Johi.
36	20th to 31st July 1936.	Mulkraj, Fieldman	Khairpur, Sukkur.	Bhiria Road, Akro, Thari, Sorah, Mamro, Rohri.
37	24th July to 2nd August 1936	L. R. E. Mr. D. R. Bhatia, Devkinandan upto Girasars.	Jodhpur, E. Jaisalmer, Bikaner.	Phalodi, Nokh, Girasars, Sri Kolayatji, Sardarshahr, Rattangarh.
37 (b)	29th July to 13th August 1936.	Devkinandan, Fieldman.	E. Jaisalmer, Jodhpur.	Girasars, Mankasars, Barsilpur, Charanwala, Kanarsar, Phalodi.
38	2nd to 13th August 1936.	Girdhari Lal, Fieldman.	Tharparkar, Malani.	Hayatjo-tur, Gundi, Sirwa, Dhorimana, Sanawa, Sarli, Barmer.

No.	Duration of Tour	Personnel touring	Districts visited.	Routes followed.
30	14th August to 4th September 1936	Mr D. R. Bhatia, (Girdhari Lal upto Chachro, Mohd Taj after that)	Sheo, Mallani, Tharparkar	Shoe, Chohtan, Dedusar, Charnor, Chachro, Khisar, Gadra, Barmor.
39 (a)	5th to 11th September 1936	Mohd Tej, Fieldman	Tharparkar ..	Gadra, Kharri, Parna, Kantio
40	4th August to 2nd September 1936	Peshawari Singh, Fieldman.	Bikaner .	Sonpalsar, Karnisar, Mahajan, Lunkaransar, Kalasar, Motigarh, Pugal, Amarpura, Motawatan, Gajner, Sri Kolayatji, Nal, Bikaner, Kanasar, Napasar, Sajauwas, Bambu, Sujangarh. Rattan-garh
41	17th August to 7th September 1936	Shanti Sarup, Fieldman,	Jaisalmer, Jodhpur.	Baru, Choyan, Lathi, Pokaran, Untwala, Barnora, Osian, Lohawat, Chula, Phalodi
42	1st to 19th September 1936.	Khushi Mohd, Fieldman.	Karachi, Dadu, Larkana	Jhampir, Thano Bulu Khan, Kotri, Schwan, Dridu, Johi, Phulji, Larkana, Akil, Kambar, Karachi
43	3rd to 8th September 1936.	Mulkraj, Fieldman	Bahawalpur ..	Ahmadpur East, Derawar.
41 (a)	6th to 19th September 1936	Mr D. R. Bhatia, L R E from Bikaner, Devkiman-dan from Nokh to Kolayatji, Narayan Behari from Sardar-shahr to Bhatinda	Jodhpur, L. Jaisalmer, Bikaner, Patiala State	Phalodi, Nokh, Girasar, Sri Kolayatji, Bikaner, Sardarshahr, Sonpalsar, Malkisar, Mahajan, Suratgarh, Bhatinda.
44 (b)	12th September to 13th October 1936	Devkiman-dan, Fieldman (Mr. D. R. Bhatia also at Baitu)	Bikaner, L. Jaisalmer, Bahawalpur, Dera Ghazi Khan, Jodhpur.	Kolayatji, Gura, Minkasar, Barsulpur, Rukanpur, Dharibut, Mithra, Dera-war, Ahmedpur East, Dera Ghazi Khan, Barmer, Baitu, Jodhpur, Osian, Lohawat, Phalodi.
44 (c)	20th September to 9th October 1936	Narayan Behari, Fieldman.	Patiala State, Hissar, Bikaner.	Bhatinda, Ramian, Bara Gudha, Sirsa, Bhattu, Adampur Mandi, Hussu, Sadulpur, Tehsil Bhadra, Nohar, Sahwa, Buchawas
45	13th to 10th September 1936.	Mulkraj, Fieldman	Khairpur ..	Bharia Road, Akro, Thari, Sorah, Kot Diji.

No.	Duration of Tour.	Personnel touring.	Districts visited.	Routes followed.
46	16th September to 13th October 1936.	Mohd Taj, Fieldman	Tharparkar ..	Misree Shah, Pilo-jo-tur Virawah, Jhangro, Islamkot, Bhakno, Diplo, Singalo, Mithi, Chellar.
47	21st September to 12th October 1936.	Mulkraj, Fieldman	Khairpur, S. Jaisalmer Sheo.	Sorah, Bowato, Ratnahu, Angsoi, Sanchoi, Wanki-Khui, Santrahu, Mayajlar, Serar, Lakha, Sheo, Barmer.
48	15th October to 10th November 1936.	Narayan Behari with Mr. D. R. Bhatia from 2nd October 1936 (i.e., Mahajan to Rattangarh).	Bikaner ..	Rattangarh, Sujangarh, Sandwa, Jasrasar, Surpura, Bikaner, Bandrawala, Surasar, Pugal, Rojri, Anupgarh, Suratgarh, Mahajan, Lunkaransar, Malkisar, Sonpalsar, Sardarshahr and Rattangarh.
49	15th October to 12th November 1936.	Girdharilal, Fieldman with Mr. D. R. Bhatia from 17th—28th October 1936 (i.e. Gadra to Umerkot).	Tharparkar ..	Baimoi, Gadra, Khisar, Chachro, Kantio, Umarmkot, Charkari, Chellar, Mithi, Islamkot, Erinalo, Chachro.
50	16th October to 13th November 1936.	Shanti Sarup, Fieldman.	E. Jaisalmer ..	Girasar, Mankasar, Barsilpur, Ranjitpur, Joluwala, Rohirwala, Bahla, Sultana, Ramgarh, Bhadasar, Jaisalmer, Hamira, Mohangarh, Tarana, Awai, Nokh
51	19th to 31st October 1936.	Mulkraj, Fieldman	Mallau ..	Balera, Chohtan, Rabasar, Dhorimana, Gura, Malpura.
52	5th to 12th November 1936.	Mulkraj, Fieldman	..	Baitu, Balotra, Makalsar, Jalor, Bhinnal, Raniwara.
53	16th to 24th November 1936.	Mr. D. R. Bhatia and Mulkraj, Fieldman.	Jodhpur, E. Jaisalmer.	Phalodi, Nokh, Girasar, Sidan.
54	16th to 26th November 1936.	Girdharilal, Fieldman.	Tharparkar ..	Charnor, Katahur, Kharee, Parna, Kantio.
55	18th to 24th November 1936	Shanti Sarup, Fieldman.	E. Jaisalmer, Jodhpur.	Baru, Lathi, Pokaran, Phalodi, Nokh.
56	19th to 27th November 1936	Narayan Behari, Fieldman.	Bikaner ..	Buchawas, Sahwa, Nohar, Churu.

STATEMENT A.-II.

Mekran Area.

Serial No.	Duration of Tour	Personnel touring.		Districts covered.	Routes followed.
	<i>Pishukan-Jiwani-Suntsar Area</i>				
1	4th to 10th December 1936	Fieldman Sharif.	Mohd.	Pishukan Area	Gwadar, Pishukan, Jiwani, Gabd, Suntsar, Gwadar.
2	15th to 19th January 1936.	Survey Assistant Mr. R. U. Butt and Fieldman Sharif	Mohd.	Do.	Gwadar, Akara, Kunar, Chah, Pishukan, Jiwani, Gabd, Suntsar.
3	12th to 18th February 1936	Fieldman Sharif	Mohd.	Do.	Gwadar, Pishukan, Jiwani, Gabd, Suntsar
4	10th to 17th March 1936.	Fieldman Sharif	Mohd.	Do.	Gwadar, Suntsar, Gabd, Jiwani, Pishukan, Gwadar.
5	8th to 14th April 1936.	Fieldman Sharif	Mohd.	Do.	Gwadar, Suntsar, Gabd, Jiwani, Pishukan, Akara, Gwadar.
6	7th to 12th May 1936	Fieldman Sharif.	Mohd.	Do.	Do.
7	10th to 15th June 1936.	Fieldman Sharif	Mohd.	Do.	Gwadar, Akara, Pishukan, Jiwani, Gabd, Suntsar, Gwadar.
8	6th to 12th July 1936.	Fieldman Tuffail.	Mohd.	Do.	Do
9	7th to 11th August 1936	Fieldman Tuffail	Mohd.	Do.	Gwadar, Suntsar, Gabd, Jiwani, Pishukan, Gwadar
10	5th to 12th September 1936.	Fieldman Tuffail	Mohd.	Do.	Do.
11	8th to 15th October 1936	Fieldman Tuffail	Mohd.	Do.	Do
12	7th to 14th November 1936.	Fieldman Tuffail.	Mohd.	Do.	Gwadar, Suntsar, Gabd, Kalatu, Jiwani, Ganz, Pishukan, Akara.
	<i>Ormara-Kalimat Area.</i>				
13	9th to 25th December 1936.	Fieldman Rahman.	Abdur	Ormara Area	Pasni, Rumra, Gazeerah, Kalimat, Zat, Kurmani, Ormara, Maniji Kaur, Pirkalat, Had, Chah, Ormara Hill, Basole, Mahola, Buzi, Rumra, Pasni.
14	14th to 31st January 1936.	Fieldman Rahman.	Abdur	Do.	Do.

Serial No	Duration of Tour.	Personnel touring.	Districts covered.	Routes followed.
	<i>Ormara-Kalimat Area—contd.</i>			
15	7th to 17th February 1936.	Survey Assistant Mr. R. U. Butt and Fieldman Abdur Rahman.	Ormara Area	Pasni, Rumra, Sanari Chah, Gazo Chah, Kalimat, Makola, Buzi, Basole, Kurmani, Kandelak, Ormara, Pirikalat, Had, Chad, Manji Kaur, Ormara, and thence by steamer to Pasni.
16	10th to 25th March 1936.	Fieldman Abdur Rahman.	Do. ..	Pasni, Rumra, Gazo Chah, Kalimat, Razak, Zat, Kurmani, Ormara, Manji Kaur, Pirikalat, Had, Chad, Basole, Makola, Rumra, Pasni.
17	13th April to 1st May 1936.	Fieldman Abdur Rahman.	Do. ..	Do.
18	14th to 26th May 1936.	Fieldman Abdur Rahman.	Do.	Do.
19	12th to 22nd June 1936.	Survey Assistant Mr. Rashid Ahmed and Fieldman Yaqub.	Do. ..	Pasni, Brangoli, Rumra, Gazechah, Kalimat, Rezak, Zat, Kurmani, Kandelak, Ormara, Pirikalat, Had, Chad, Ormara, Basole, Makola, Buzi, Rumra, Pasni.
20	10th to 26th July 1936.	Fieldman Basham Nath.	Do. ..	Pasni, Rumra, Kalimat, Zr, Kurmani, Ormara, Manji Kaur, Had, Chad, Pirikalat, Basole, Makola, Rumra.
21	12th to 26th August 1936.	Fieldman Basham Nath.	Do. ..	Do.
22	17th September to 1st October.	Fieldman Basham Nath.	Do. ..	Do.
23	18th October to 1st November 1936.	Fieldman Basham Nath.	Do. ..	Do.
24	15th to 27th November 1936.	Fieldman Basham Nath.	Do. ..	Do.

Serial No	Duration of Tour.	Personnel touring.	Districts covered.	Routes followed.
	<i>Turbat-Panjgur-Kolwa Area.</i>			
25	1st to 7th December 1935.	Fieldman Mohd. Khushi	Panjgur, Buleda	Panjgur, Khudabadan Iraf, Thana Daragh, Shakrak, Kirki, Buleda, Turbat.
26	18th to 28th December 1935.	Assistant Entomologist Dr. Roonwal, Survey Assistant (Mr. Ahmed Rashid)	Kech Area ..	Pasni, Ghulamani Bent, Pidarakh, Turbat, Nasirabad, Shashtal, Turbat, Pasni.
27	5th to 19th February 1936.	Fieldman Mohd. Khushi	Kech, Buleda, Parom.	Turbat, Nasirabad, Tump, Mand, Aspikan, Wakar, Purchinan, Siagisi, Sariparom, Dardumagh, Buleda, Turbat.
28	13th March to 3rd April 1936.	Fieldman Mohd. Khushi	Kolwa, Panjgur Buleda.	Turbat, Sami, Hoshab, Rodkhan, Chamber, Kalat, Goshanak, Awaran, Godri, Saleri, Mitha, Singh, Panjgur, Thana Daragh, Shakrak, Buleda, Turbat.
29	15th to 30th April 1936.	Fieldman Mohd. Khushi	Kech-Buleda	Turbat, Nasirabad, Tump, Mand, Aspikan, Wakar, Purchinan, Siagisi, Sari Parom, Dardumagh, Buleda, Turbat
30	22nd May to 4th June 1936.	Fieldman Mohd. Khushi	Kech—Buleda	Do.
31	11th to 28th June 1936.	Fieldman Mohd. Khushi	Kolwa, Panjgur, Buleda.	Turbat, Sami, Hoshab, Rodkhan, Chamber, Kalat, Goshanak, Awaran, Godri, Saleri, Panjgur, Thana Daragh, Shakrak, Kirki, Buleda, Turbat.
32	8th to 24th July 1936.	Fieldman Naurata Singh.	Kech-Buleda	Routes as in Tour 29.

Serial No.	Duration of Tour.	Personnel touring.	Districts covered.	Routes followed.
	<i>Turbat-Panjgur-Kolwa—contd.</i>			
33	28th June to 26th July 1936.	Survey Assistant, Mr. Rashid Ahmed and Fieldman Mohd. Sharif (in part).	Shadi Kaur, Turbat, Bulda, Panjgur, Kolwa	Pasni, Ghulamani Bent, Pedarak, Turbat, Langkahur, Bulda, Kirki, Shakrak, Thana, Datagh, Panjgur, Jori, Godri, Awaran, Goshanak, Chambar, Kalat, Rodkhan, Hoshab, Sami, Turbat, Pedarak, Pasni
34	3rd to 18th August 1936.	Fieldman Naurata Singh.	Kolwa-Kech.	Turbat, Sami, Hoshab, Rodkhan, Hoshab, Hirok, Turbat, Nasirabad, Shashital, Turbat.
35	1st to 8th August 1936.	Fieldman Sharif. Mohd.	Panjgur Area	Panjgur, Sor-Ap, Seligaran, Gar, Daragh-i-Daf, Shalibez, Kalat, Panjgur.
36	15th to 21st August 1936.	Fieldman Sharif. Mohd.	Rakshan Valley	Panjgur, Kangichah, Pissi, Nagi-Kalat, Pissi, Kangichah, Panjgur.
37	27th to 30th August 1936.	Fieldman Naurata Singh.	Kolwah ..	Turbat, Sami, Hoshab (and thence with Survey Assistant in Kech and Bulda).
38	27th August to 28th September.	Survey Assistant, Mr. Rashid Ahmed and Fieldman Naurata Singh from Hoshab.	Kolwa, Kech, Parom, Bulda	Pasni, Zabrikahur, Kahori, Kandak, Karochi Dat, Hoshab, Rodkhan, Hoshab, Sami, Turbat, Nasirabad, Nodez, Tump, Mand, Ispikan, Wakai, Kumbhi-Kalat, Zaidi, Parom, Gar, Duz-Parom, Shinzu, Kalag, Bulda, Turbat, Pedarak, Ghulamani Bent, Pasni.
39	1st to 23rd September 1936.	Fieldman Sharif. Mohd.	Panjgur, Balgatar, Kolwah.	Panjgur, Sor-Ap, Gar, Daragh-i-Daf, Dashedi Shalibez, Pirgan, Tash, Mazarichah, Hoshab, Rodkhan, Hor Kalat, Chambar, Kalat, Goshanak, Awaran, Godri, Saleri, Mitha Singh, Panjgur.

Serial No	Duration of Tour.	Personnel touring.	Districts covered.	Routes followed.
	<i>Turbat Panjgur-Kohua—concl'd</i>			
40	1st to 7th October 1936.	Fieldman Mohd. Sharif.	Panjgur-GarArea	Panjgur, Sor-Ap, Gar, Daragh-i-Daf, Dasht Shahbaz, Panjgur
41	5th to 10th October 1936.	Fieldman Naurata Singh.	Kech ..	Turbat, Sami, Hoshab, Sami, Turbat.
42 (a)	16th to 20th October 1936.	Fieldman Shamsul Hassan.	Nodez Area ..	Turbat, Nasirabad, Shashtal, Turbat.
43	1st to 12th November 1936.	Fieldman Shamsul Hassan.	Kech Valley ..	Turbat, Nasirabad, Shashtal, Tump, Nasirabad, Turbat.
	<i>Kulanch-Dasht Area</i>			
44	29th December 1935 to 20th January 1936.	Fieldman Khushi Mohd.	Kulanch-Dasht	Pasni, Kandasole, Chukien, Saur Kaur, Kappar, Ban, Kuhak, Bishuli, Zaren Bug, Suntear, Shahjangi, Kalat, Kuntidar, Kuhak, Ban, Nokbur, Sardasht, Ghulamani Bent, Pasni.
45	8th January to 24th January 1936	Survey Assistant Mr. R. U. Butt.	Kulanch-Dasht	Pasni, Chakuli, Kandasole, Chukin, Kappar, Gwadar, Suntear, Zarenbug, Kuddan, Ban, Nokbur, Pasni.
46	23rd February to 4th March 1936.	Loc. Res. Entomologist Assistant Ent. Dr. Roonwal, Survey Assistant R. U. Butt.	Kulanch-Dasht, Kech.	Pasni, Sardasht, Nokbur, Ban, Kuddan, Daren, Shashtal, Nasirabad, Nodez, Turbat, Pidaral, Ghulamani Bent, Pasni.
47	19th March to 6th April 1936.	Fieldman Ali Haider	Kulanch-Dasht	Routes as in Tour No. 44.
48	30th March to 1st April 1936.	Survey Assistant Mr. R. U. Butt.	Kandasole ..	Chakuli, Kandasole and Pasni.
48 (a)	5th to 10th April 1936.	Assistant Entomologist Dr. M. L. Roonwal.	Kandasole ..	Kandasole, Chakin and Pasni.
49	18th April to 5th May 1936.	Survey Assistant Mr. R. U. Butt and Fieldman Ali Haider.	Kulanch-Dasht, Gwadar.	Pasni, Sardasht, Nokbur, Ban, Kuddan, Kuntidar, Shahjang, Kalat, Zarenbugi, Hasadi, Shali, Suntear, Gwadar, Nigwar, Kappar, Kandasole, Pasni.

Serial No	Duration of Tour.	Personnel touring.	Districts covered.	Routes followed.
	<i>Kulanch-Dasht Area—contd.</i>			
50	14th to 22nd May 1936.	Fieldman Ali Haider	Kulanch ..	Pasni, Chakuli, Kandacole, Chukin, Kappar, Ban, Nokkur, Sardasht, Pasni.
51	21st May to 2nd June 1936.	Survey Assistant Mr. Rashid Ahmed	Kulanch-Kech	Gwadar, Karwat, Kappar, Kandacole, Chakuli, Pasni, Ghulwani Bent, Pidarak, Turbat, Nasirabad, Shashtal, and back to Turbat and Pasni.
52	6th to 13th June 1936.	Fieldman Mohd. Taffail.	Kulanch-Dasht	Pasni, Kandacole, Karwat, Ban, Kuchak, Kiki, Talang.
53	23rd July to 9th August 1936.	Fieldman Shamsul Hussain.	Kulanch-Dasht	Route followed as in Tour No. 44.
54	29th August to 14th September 1936.	Fieldman Shamsul Hussain.	Do. ..	Route as in Tour No. 44.
55	10th to 25th October 1936.	Fieldman Mashtaq Hussain.	Do. ..	Route as in Tour No. 44.
56	5th to 20th November 1936.	Fieldman Mashtaq Hussain.	Do. ..	Route as in Tour No. 44.

STATEMENT A.-III.

Lasbela Area.

Serial No.	Duration of Tour.	Personnel touring.	Districts.	Routes followed.
<i>Hinidan Area.</i>				
1	29th November to 10th December 1935.	Mr. R. N. Batra and Fieldman Md. Shafi	Hinidan Area.	Habchowki, Thana Kila, Koh Mahir, Moidan, Hinidan, Shah Bilawal, Got-Sherkhan, Ambagh.
2	10th to 21st April 1936.	Fieldman Naurata Singh.	Do.	Got Sherkhan, Shah Bilawal, Hinidan, Thana Kila, Got Moidan, Habchowki, Gandhako, Bhiwani, Ambagh.
3	17th to 27th July 1936.	Fieldman Harbans Lal.	Do.	Windar Bala, Mindiari Kaur, Got Sherkhan, Shah Bilawal, Hinidan, Thana Kila, Got Moidan, Hab Chowki, Sihani, Bhiwani, Ambagh.
4	11th to 23rd September 1936.	Fieldman Md. Shafi	Do.	Ambagh, Lak Badok, Karachi, Hab Chowki, Gandhakoh, Thana Kila, Koh Mahir, Got Moidan, Hinidan, Kand Kaur, Shah Bilawal, Got Sherkhan, Bala Windar, Ambagh.
5	3rd to 14th November 1936.	Fieldman Md. Shafi	Do.	Bala Windar, Mindiari Kaur, Got Sherkhan, Shah Bilawal, Hinidan, Koh Mahir, Thana Kila, Got Moidan, Hab Chowki, Ambagh.
<i>Hingol Area.</i>				
6	20th December 1935 to 6th January 1936	Mr R. N. Batra and Fieldman Md Shafi	Hingol Area.	Ambagh, Liari, Sheikhraj, Nakhtri, Chandragup, Sapat, Sangal, Devri, Kund, Sangal, Khandewari, Pohr, Liari, Banodi, Uthal, Ambagh.
7	13th to 28th February.	Fieldman Dinanath	Do.	Liari, Sheikhraj, Khandewari, Pohr, Sangal, Kund, Chandragup, Nakhtri, Liari, Banodi, Ambagh.
8	24th April to 11th May.	Fieldman Naurata Singh.	Do.	Liari, Sheikhraj, Baddo, Khandewari, Pohr, Sangal, Kund, Chandragup, Nakhtri, Liari, Banodi, Uthal, Ambagh.
9	30th May to 12th June.	Fieldman Naurata Singh.	Do.	Liari, Sami Pir, Phat, Sheikhraj, Khandewari, Kan Barar, Pohr, Sangal, Kund, Chandragup, Nakhtri, Liari, Ambagh.

Serial No.	Duration of Tour.	Personnel touring.	Districts.	Routes followed.
	<i>Hingol Area—contd.</i>			
10	3rd to 20th August 1936.	Fieldman Dinanath	Hingol area.	Lari, Sheikhraj, Khandewari, Kan Barar, Pohr, Sangal, Devri, Hingol, Kund, Chandragup, Nakhtri, Lari, Banodi, Uthal, Ambagh.
11	5th to 24th October 1936.	Fieldman Md. Shafi	Do.	Lari, Sheikhraj, Khandewari, Kan Barar, Pohr, Sangal, Devri, Kund, Hingol, Chandragup, Nakhtri, Lari, Kharrari Nadi, Uthal, Kantro Nadi, Ambagh.
12	16th to 27th November 1936.	Fieldman Md. Shafi	Do.	Sami Pir, Lari, Sheikhraj, Khandewari, Kan Barar, Sangal, Devri, Kund, Chandragup, Nakhtri, Lari, Ambagh.

STATEMENT-B-1 (1).
Details of Locust Findings in Sind-Reputana Desert Area.

Season.	Thar-Parkar Mallani Area			E. Jasalmer N. Marwar.			Bikaner Area.		
	Localities.	Locusts.		Localities	Locusts.		Localities.	Locusts.	
		No. found.	Approximate population density per sq. mile.		No. found.	Approximate population per sq. mile.		No. found.	Approximate population per sq. mile.
Winter. December to February	16-20 vii: A-I (5).	1	16	2-12 vii: A-I (2)	1	?	2-15 vii: A-I (1).	Nil.	
	19 vii Bantu ..	..	..	5-xii Raschandwala-Bijot	1	?	Pugal-Nokh area ..	Nil.	
	11-14 vii: A-I (3).	..	..	6 vii Bijot	1	?	15-30 vi: A-I (3).	Nil.	
	Shico area ..	Nil.	Nil.	12-28 vi: A-I (11).	1	?	Pugal Rojri area ..	Nil.	
	6-15 xii: A-I (3).	..	..	15 ii Parna ..	1	30			
	Chalvir area ..	..	..	17 ii Molungparh	2	60			
	17-20 vii: A-I (6).	..	..	18 ii Do	10	949			
	18-vi Chipur Khosa	..	..	19 ii Basanpur	5	199			
	19-vi C-Godra	..	..	20 ii B-Sodakhori	3	180			
	11-19 i: A-I (7).	1	60	22 ii S-Chandisar	1	60			
	16 i Chaur Khosa	1	30	23 ii Chandisar	1	90			
	17-i Do.	2	60						
	18-i Ch-Godra	1	30						
	19-29 i: A-I (9).	4	96						
Thar area ..	20 i Kharri ..	8	308						
	21-i Kharri-Parna ..	5	75						
	22-23 i Parna ..	Nil.	Nil.						
	13-29 ii: A-I (13).	..	..				
	Thar area ..	..	..				
Mallani area ..	22-ii i-iii: A-I (14 & 15).	..	..				
	Mallani area ..	..	..				

Spring, March to May	5-II iii: A-I (17).		1	?		13-21 iii: A-I (18).		1	30		1 H (1V)	4-18 iii: A-I (16).		Nil.
	7-iii Gdwa ..	3-4 iv: A-I (20b).	..	..	..	10-iii Charnuwa Bawalpur ..	9 iv Nakh-Phalodi ..	1	120	..	..	Nohar-Rent, etc.	..	Nil.
	Kantio, etc. ..	..	..	Nil.	..	5-29 iv: A-I (22).	..	..	..	..	..	Pugal area ..	..	Nil.
	Chachro-Gdwa area ..	..	..	Nil.	..	22-iv Tanna to Mohan- grah ..	..	1	30	..	..	10-14 v: A-I (23a).	..	Nil.
	6-25 v: A-I (24).	..	..	Nil.	..	Mohangrath ..	..	..	..	..	..	Bilamer area ..	..	Nil.
	Southern Thra area ..	..	..	Nil.	..	17-26 v: A-I (25).	..	..	..	..	..	..	..	..
Summer, June to August	1-24 ii: A-I (26)	..	..	..	..	1-25 vi: A-I (23).	..	8	610	..	..	2-28 i: A-I (27 & 31).	..	2
	3-v Hajat-jo-Tur ..	..	..	60	..	1-vii Nakh-Gimmar ..	..	4	210	..	..	9-v Surpura ..	..	Nil.
	6-vi Chachro-Gdwa ..	..	..	30	..	2-vii Gimmar ..	..	1	80	..	..	All other places ..	..	..
	12-vi Dhannu-Gdwa ..	..	..	50	..	7-vii Mankar ..	..	1	120	..	..	1-24 vi: A-I (24).	..	..
	19-vi Karmer ..	..	..	80	..	8-vii Jolwala ..	..	2	160	..	..	2-vii Sompur to Lun- karuwar ..	..	8
	20-vi Do ..	..	..	..	..	10-11-vi Bahl ..	..	2	70	..	..	3-vii Lunkarwar ..	..	5
	21 vi: A-I (27).	..	..	..	..	12-vi Nakh-Gdwa ..	..	1	80	..	..	4-vii Ropar ..	..	5
	Gdwa-Mithi (except at Chachro).	..	..	Nil.	..	16-vi Badliwar ..	..	0	490	..	..	5-6-vii Mohangrath ..	..	5
	2-30 iii: A-I (32a)	..	..	..	..	19-vi Jalsowar to Mohangrath ..	..	1	60	..	..	7-8-vii Bahl ..	..	0
	5-8 v: Dipo ..	..	..	107	..	20-vii Mohangrath ..	..	1	210	..	..	9-vii Ropar ..	..	2
	12-13 vi: I bankot ..	..	..	60	..	21-vii Mankar ..	..	3	..	..	..	15-vii Gaingnagar ..	..	1
	14-vii Pankot-Somalbo ..	..	..	60	..	24-vii Nakh-Gimmar ..	..	..	..	..	..	17-vii Nohar ..	..	2
	15-vii Son-jo ..	..	..	60	..	Gimmar ..	..	2	100	..	..	18-vii Nohar Solya ..	..	2
	22-vii Karwar ..	..	..	20	..	29 vii Do ..	..	1	210	..	..	19-vii Sahra ..	..	1
	24-vii Rama ..	..	..	210	..	30-vii Do ..	..	..	..	..	..	20-vii S. Buchanas ..	..	1
	26 vii Panna-Kh-mi ..	..	..	300	..	30-vii G. Kolyaji ..	..	..	..	..	..	..	..	..
	27-vii Kh-mi ..	..	..	180	..	30-vii Sri Kolyaji ..	..	..	..	..	..	..	..	..
	28-vii Chachro-Kh-mi ..	..	..	180	..	2 viii Rattangrath ..	..	..	..	..	..	..	..	..
	30 vii Ch Chachro ..	..	..	120	..	..	..	..	..	..	..	..	..	..
	2-17 vii: A-I (35).	..	..	115	..	29 vii: A-I (37b).	..	..	..	..	..	4-31 vii: A-I (40).	..	1
	3-viii Hachro-Tur ..	..	..	160	..	1-viii Mankar ..	..	..	..	..	..	5-viii Karwar ..	..	68
	9-viii Sarya Dornmua ..	..	..	..	..	2-viii Do ..	..	..	..	..	..	6-viii Do ..	..	101
	6-viii D-Sarya ..	..	..	..	..	3-viii M. Parsapur ..	..	..	..	..	..	7-viii K. M. Jhyan ..	..	120
	11-viii Sarya (New G.n.)	..	..	120	..	4-viii Barulpur ..	..	..	..	..	..	8-viii Mahajan ..	..	80
	..	..	..	..	..	5-viii Do ..	..	..	..	..	..	9-viii Lunkarwar ..	..	..
	..	..	..	..	..	10-viii Karwar ..	..	1	120	..	..	..	..	..
	..	..	..	..	..	..	..	1	120	..	..	..	..	..

STATEMENT B-I (1)—contd.
Sind-Rajputana Areas.

	Thar Parkar-Vallabhi Area.				E. Jaisalmer N. Marwar.				Bakner Area.			
	Localities.		Locusta.		Localities.		Locusta.		Localities.		Locusta.	
	No. found.	Approximate population density per sq. mile.	Hoppers if any.		No. found.	Approximate population per sq. mile.	Hoppers if any.		No. found.	Approximate population per sq. mile.	Hoppers if any.	
cont'd.	9-31 viii: A I (39)				17 viii 7 ix: A-I (11)				14-viii Motigarh Pugal 15-16 viii Pugal 17-viii P. Amarpur 18-viii Arampur 19 viii A Motgarh 21 viii S. Kolayatji 21 viii Nal 21-viii Kanner 26 viii N. Jaisalmer 27 viii N. Jaisalmer 29 viii S. Pugal 29 viii S. Pugal			
	13 viii Ramgarh	2	96	3 H	17 viii Nokh-Baru	8	960		10	150	30H	
	17-viii Shree-Burnor (N.G.)	1	210	2 H	19 viii Baru	5	200		5	150		
	18 viii Barmer	1	210		20 viii Baru Choyan	12	360		5	150		
	19 viii Barmer	3	210		21 viii Choyan	21	840		3	120	1H	
	20 viii B Chohan	3	120	1 H	22-viii Choyan-Lathi	8	480		2	60		
	21-viii Chohan	3	120		23-viii Choyan-Lathi	31	630		2	60		
	22-viii Dedhar	1	27		24-viii Choyan-Lathi	8	480		2	60		
	23-viii Dedhar	10	300		25-viii Choyan-Lathi	1	30	1H (V)	2	60		
	24-viii D Chohan	5	265		26-viii Choyan-Lathi	1	30		2	60	2H	
	25-viii Chohan	5	265		27-viii Choyan-Lathi	1	30		2	60		
	26-viii Chohan	7	210		28-viii Choyan-Lathi	1	30		2	60		
Autumn. September to November.	1-11 ix: A-I (39a)				12-ix-13 x: A I (46)				6-19 ix: A-I (46a)			
	1 ix Chachro Khwar	1	10		A-I (44a) (in part)	6	1,920		1	53	6H	
	2-ix Khwar (1)	10	800		7 ix Phalodi Nokh	18	720		1	53	4H	
	3-ix Do (2)	19	9,120		10 ix Nokh Barmer	18	720		10	600		
	4-ix Do	10	430		11 ix G S. Kalyatji	2	110		10	600		
	5 ix Gedra-Kharri	10	180		12 ix G S. Kalyatji	2	110		10	600		
	6 ix Kharri Parra	6	210		13 ix G S. Kalyatji	2	110		10	600		
	7-ix Parra	10	400		14 ix G S. Kalyatji	2	110		10	600		
	8 ix Parra-Kantilo	9	300		15 ix G S. Kalyatji	2	110		10	600		
	9-10 ix Kantilo	12	1,751		16 ix G S. Kalyatji	2	110		10	600		
	11-ix Kantilo-Chachro	6	210		17 ix G S. Kalyatji	2	110		10	600		
					18 ix G S. Kalyatji	2	110		10	600		
					19 ix G S. Kalyatji	2	110		10	600		

16-12-13-2: A-I (16).			6-12-2: A-I (14b).			20-12-9-2: A-I (44c).			16-2-10-2: A-I (43).			1-12-2: A-I (43 in part).			20-27-2: A-I (55).		
16-ix Chachro-Misri Shah	2	80	12-x Phalodi-Nokh ..	2	130	21-ix Raman ..	1	150	20-x Jamsar	2	60	1-12-2: A-I (43 in part).	19	1,520	20-27-2: A-I (55).	1	120
24-ix Jivugro Islamkot	7	280	16-x-23-x: A-I (50).	13	2,160	4-x Nohar ..	5	150	22-x Surpur ..	4	120	2-x Mahajan ..	19	2,432	21-x Buchawas Sahwa	2	120
28-ix Islamkot ..	1	30	17-x Girsar ..	15	900	5-x Nohar Sahwa	1	600	23-x Bikaner-Bandrawa-	1	60	3-x Mahajan ..	3	109	22-x Sahwa ..	2	120
8-x Mithi ..	1	10	18-x G-Manikar ..	6	480	6-x Sahwa ..	20	600	24-x B-Rajputpura ..	3	180	4-x Mahajan ..	10	640	22-x Sardarshahr to	17	1,020
13-x Chellur to Chachro	1	40	19-x M-Bansipur ..	10	1,200	8-x Buchawas ..	1	60	25-x B-Johawala ..	13	900	5-x Mahajan ..	10	640	Sonpalsar.		
7-x-29-x: A-I (49a).			20-x B-Rajputpura ..	3	180				26-x B-Bandrawala ..	39	1,170	6-x Mahajan ..	10	640			
7-x Bala ..			21-x B-Rajputpura ..	13	900				27-x B-Pugal ..	27	540	7-x Mahajan ..	32	7,080			
10-x Gadra-Khalsar ..	3	120	22-x B-Johawala ..	8	960				28-x B-Pugal-Rojri ..	23	690						
20-x Khisar ..	1	107	23-x B-Johawala ..	8	960				29-x B-Pugal-Rojri ..	27	810						
21-x Khisar-Chachro ..	5	205	24-x B-Johawala ..	1	60				30-x B-Pugal-Rojri ..	1	60						
27-x Kantio ..	2	240	25-x B-Johawala ..	1	60				1-x Anupgarh ..	1	120						
15-x Parna ..	1	120	26-x B-Johawala ..	13	960				2-x Anupgarh ..	1	120						
17-x Gadra ..			27-x B-Johawala ..	11	880				1-12-2: A-I (43 in part).								
19-31-2: A-I (51).			28-x B-Johawala ..	11	880				2-x Mahajan ..								
28-x Gurba ..	1	40	29-x B-Johawala ..	15	1,200				3-x Mahajan ..								
29-x Gurba-Malpura ..	1	60	30-x B-Johawala ..	10	1,280				4-x Mahajan ..								
30-x Malpura ..	1	60	31-x B-Johawala ..	6	480				5-x Mahajan ..								
29-x-12-x: A-I (49).			32-x B-Johawala ..	6	480				6-x Mahajan ..								
10-xi Islamkot-Ernialo	1	240	33-x B-Johawala ..	6	480				7-x Mahajan ..								
10-26-2: A-I (50).			34-x B-Johawala ..	18	1,440				8-x Mahajan ..								
25-xi Kantio ..	3	240	35-x B-Johawala ..	29	1,160				9-x Mahajan ..								
5-12-2: A-I (52).			36-x B-Johawala ..	13	680				10-x Mahajan ..								
Balotra-Jalor area ..		Nul.	37-x B-Johawala ..	34	10,320				11-x Mahajan ..								
			38-x B-Johawala ..	4	960				12-x Mahajan ..								

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Season.	Hindian Area. (Interior Tract.)	Locusta.			Hingol Area. (Coastal Tract.)	Locusta.		Hoppers if any.
		Number of Adults.	Approximate population rate per sq. mile.	Hoppers if any.		Number of Adults.	Approximate population rate per sq. mile.	
Winter December to February.	29. XI-10. XII-A-III (1). 5-xii Kila Hindan .. 6-vii Koh War area .. 7-xii Katar Kaur area ..	1 5 2	30 100 40		20. XII-135.6-1-136-A-III (6). 21-xii Sheikhrai 27-xii Nakhtri 24-xii Nakhtri to Chandragup .. 25-xii Chandragup 29-xii C to Kund 27-xii Kund area 28-xii Kund Sangal 29-xii Devri Sangal 30-xii Sengal-Khandewari .. 31-xii Pohr Rets 1-1-30 Khandewari 13-29-17-1-III (7). 14 ii Sheikhrai 17-ii Khandewari 18 ii Khandewari to Sangal .. 19-ii Sangal 21-ii Kund 22 ii Kund to Chandragup .. 24-ii Chandragup 21 ii Chandragup to Nakhtri .. 25-ii Nakhtri (Many specimens had pink or mauve colour on wings.)	3 3 3 1 7 10 8 16 24 1 57 31 1 15 1 6 3 1 8 8 9	60 48 24 112 150 128 230 24 24 1,140 496 60 360 30 144 72 60 102 192 216	
Spring. March to May ..	10 20 IV-A-III (2). Locusta not found anywhere ..	..	Nil.		21-IV-11V-4-III (8). 26 iv Paddo Rets 29 iv Pohr Rets 30 iv Pohr to Sangal 3 v Kund area	1 4 2 2	24 160 80 80	1 II-stage hopper on 15 pr- ma.

Season.	Hindus Area, (Interior Tract)	Locusts.			Hindus Area (Coastal Tract)	Locusts.		
		Number of Adults.	Approximate population rate per sq. mile.	Hoppers if any.		Number of Adults.	Approximate population rate per sq. mile.	Hoppers if any.
Summer. June to August ..	17-27-VIII-A-III (7).				30-V-12 VI-A-III (9)			
	17-vii Ambigh to Got Shor Khan. 29 vii Bhawan area near Hab (Howa) (The specimens had all of them yellow wings; some had red mites)	9 2	410 80		30-v Ambigh-Linn .. 11-v Sheikmy .. 2-vi Kan Barar .. 3-vi Pohr Reks .. 4-vi Khindwari to Sangal .. 5-vi Bangal-Kund .. 6-vi Kund area .. (Many of the specimens carried red mites; and had hyaline or light yellow wings.)	2 1 1 11 1 1 10	60 40 40 110 160 10 400	
Autumn. September to November.	11-23 IX-A-III (5)				3-30 VIII Pohr Reks .. 7-viii Pohr Reks .. No locusts found in other places. (The specimens found had yellow wings with blue or mauve at the base.)	3	120	
	15 ix Thann Kila .. 22 ix Got Shor Khan .. 23 ix Got Shor Khan to Ambigh (Many had hyaline wings and were evidently examples of a new generation.)	1 1 1	40 40 160		5-21 X-4-III (12).			
					6-x Sheikmy .. 8-x Kan Barar .. 11-x Sangal .. 9-x Pohr Reks .. 11-x Kund area .. 17-x Chundragup .. 18-x Nakhedri .. 19-x Nakhedri .. (Most of the specimens had hyaline or light yellow wings, generally with blue or mauve patches at the base.)	1 2 3 4 7 1 2 1	40 80 120 100 280 40 80 40	

3-14 XI-A-III (5).		16-27 XI-A-III (12).			
3-xi	Got Sherhan (near Coastal area). (Specimens possessed light yellow wings with blue or mauve tinge at their bases.)	6	240	20-xi 21-xi 22-xi 23-xi 26-xi	Kan Banr area .. Saugal area .. Deviriks .. Kund area .. Lian area ..
No locusts were found in the interior parts of the region visited.					2 3 10 14 1
					80 120 760 500 60
					(Hind wings of most specimens with blue or mauve patches at the base, and either hyaline or light yellow.)

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STATEMENT C-I.
Results of Intensive Surveys on *Psani* Reks.

Month (Results given for each fortnight).	No. of Surveys.	Total No. of locusts observed during each fortnight.	Range of Population Density per sq. mile during Surveys.	Average population rate for the fortnight.	Condition of Ovaries (based on one or two sections)	Rainfall (inches).	Remarks
December 1935— 1st ..	6	39	0—107	43	..	0.33	Both new generation (probably immigrants) and old generation forms met with. Hind wings yellow or light yellow, with pink blue or mauve bases.
2nd ..	6	33	0—160	91	Immature ..	Nil	Do.
January 1936— 1st ..	6	23	0—103	21	..	1.59	Do.
2nd ..	7	92	0—223	69	Almost mature ..	Nil	Do.
February— 1st ..	7	57	15—76	61	..	Nil	Hind wings yellow, without purple bases. Red mites present on wings and body.
2nd ..	6	29	32—73	33	Fully mature ..	0.53	No hoppers found.
March— 1st ..	6	18	15—75	38	..	0.6	On 21st March, 4 L-stage and 4 II-stage hoppers found in Elmanah Special Area. The earliest date of hatching, in nature, was probably about the 15th March, and that of oviposition about the middle of February. During this fortnight, 36 green hoppers of I, II and III stages were found in the Special Areas.
2nd ..	7	55	8—120	48	..	0.06	

April— 1st ..	7	14	0—30	10	..	Nil	104 green hoppers of I to IV stages found in Special Areas. The fall in locust population is presumably due to the dying off of the old generation forms, but possibly also to emigration.
2nd ..	0	1	0—5	1	..	Nil	First new generation adult found on 18th April. 44 green hoppers of all stages found in Special Areas.
May— 1st ..	5	31	0—57	30	Immature	Nil	New generation adults. 5 green hoppers of III to V stages found.
2nd ..	7	70	0—552	166	Immature	Nil	One V stage green hopper found in Shahigurband Special Area on 18th May. The increase in population noticed towards the end of May is attributed to an immigration, probably from the west. Hindwings either clear or yellow. S. W. Winds prevalent.
June— 1st ..	0	80	00—288	193	..	Nil	No hoppers found.
2nd ..	6	82	60—600	244	Immature	..	The comparatively higher population is probably referable to a continuation of the immigration which started towards the end of May.
July— 1st ..	6	46	12—480	158	..	0-12	Population beginning to decline.
2nd ..	6	17	12—160	57	Immature	..	Population beginning to decline.
August— 1st ..	7	26	24—192	72	Immature	Nil	Population low.
2nd ..	6	12	0—64	25	..	Nil	Population low.

Month (Results given for each fortnight).	No. of Servoys.	Total No. of locusts observed during each fortnight.	Range of Population Density per sq. mile during Surveys.	Average population rate for the fortnight.	Condition of Ovaries (based on one or two dissections).	Rainfall (inches).	Remarks.
September— 1st ..	6	4	0—120	24	..	Nil	Four locusts observed during one survey only (Gurani). On all the other surveys no locusts were found. Population low.
2nd ..	7	8	0—80	26	..	Nil	Population low.
October— 1st ..	7	20	0—102	64	Immature ..	Nil	A sudden increase in population was noticed on 8th October and is attributed to an immigration, probably from Kolwa where rainfall had been received in September. The locusts observed belonged to a recent generation.
2nd ..	7	16	0—274	57	Partially mature	Nil	In the third week of October, population was almost nil. On 20th October several locusts were noticed in the vicinity of Pasmil Town and on the survey done on 20th October, the locust population worked out at 274 per square mile. The locusts belonged to a recent generation and were probably migrants from the summer breeding areas. N. E. Winds prevalent.
November— 1st ..	6	29	34—300	130	Immature ..	Nil	The immigration of clear-winged locusts continued during this period. Red mites were present on wings of many locusts.
2nd ..	6	43	0—480	166	Immature ..	0.06	Do.

STATEMENT C-II.
Results of Intensive Surveys on *Gvadar Reks*.

Month (Results given for each fortnight).	No. of Surveys.	Total No. of locusts observed during each fortnight.	Range of Population Density per square mile during Surveys.	Condition of Ovaries (based on one or two dissections).	Rainfall (inches).	Remarks.
December 1935— 1st 2nd	3 6	7 38	18—72 72—210	Partially mature .. Both mature and immature ovaries found.	0.31 0.18	
January 1936— 1st 2nd	6 6	9 83	21—72 72—720	Partially mature .. Mature	0.44 Nil	
February— 1st 2nd	6 5	75 20	48—672 72—192	Mature .. Mature	Nil 0.60	
March— 1st 2nd	3 4	10 22	48—144 72—210	Mature .. Mature	2.7 Nil	
April— 1st 2nd	3 6	8 1	48—96 0—24	.. ..	Nil Nil	11 green hoppers found (5-I, 3-II, 3-III). 29 green hoppers found (6-I, 6-II, 12-III, 2-IV, 3-V).
May— 1st 2nd	3 5	6 25	0—96 96—192	Fully mature (eggs laid). Immature	Nil Nil	New generation locusts. 3 green hoppers found (1-III, 1-IV, 1-V).

Month (Results given for each fortnight).	No. of Surveys.	Total No. of locusts observed during each fortnight.	Range of Population Density per square mile during Surveys.	Condition of Ovaries (based on one or two dissections).	Ranfall (inches).	Remarks.
June— 1st 2nd	3 7	15 32	96—144 48—168	Mature Mature	Nil Nil	
July— 1st 2nd	4 8	10 21	0—120 0—200	Immature Mature	Nil Nil	
August— 1st 2nd	3 8	7 9	30—66 0—72	Mature Immature	Nil ..	One clear-winged locust probably an immigrant from Kolwa found at Jiwani on 11th August 1936.
September— 1st 2nd	4 8	4 5	0—00 0—48	Mature Mature	Nil Nil	
October— 1st 2nd	4 5	2 3	0—24 0—30	Immature ..	Nil Nil	Hand wings yellow.
November— 1st 2nd	4 6	5 4	0—48 0—90	.. Immature	Nil 0-04	Some with clear hind wings, presumably migrants from the east. Ditto.

STATEMENT C.-III.
Results of Intensive Surveys for December 1935 to November 1936 on Ambagh-Sonmiani-Nakacharrari Reks.

Month.	Fort-night.	No. of Surveys.	Total No. of locusts observed.	Range of Population Density during Surveys.	Average population rate for the fortnight.	Colour of Hind wings.	Condition of Ovaries.	Rainfall.	Remarks.
December 1935	I	6	71	37—720	142	Hyaline or Slightly Yellow. Do.	Immature	Nil	
	II	5	46	0—132	99			Nil	
January 1936	I	5	52	0—247	104	Do. Do.	Do. Do.	0.32*	
	II	7	20	15—60	36			Nil	
February	I	6	74	0—308	117	Do. Do.	Ovaries Mature.	Nil	
	II	5	86	80—815	212			0.95*	
March	I	7	39	20—360	167	Slightly Yellow or Yellow. Do.	Mature Ovaries.	Nil	
	II	6	27	0—160	62			Nil	
April	I	6	5	0—40	17	..	..	Nil	Decrease in Population possibly due to emigration.
	II	5	4	0—80	20			Nil	
May	I	6	11	0—80	26	Yellow or Slightly Yellow. Do.	Immature .. Do.	Nil	Some had red mites on wings.
	II	6	54	13—720	167			Nil	

Month.	Fort- night.	No. of Surveys.	Total No. of locusts observed.	Range of Density during Surveys.	Average Population rate for the fortnight.	Colour of Hindwings.	Condition of Ovaries.	Rainfall.	Remarks.
June ..	I	5	69	46-740	257	Light yellow, Pink mauve or blue at base of wings.	..	Nil	Red mites present.
	II	7	96	0-560	152	Yellow Do.	..	0-38"	
July ..	I	6	26	0-260	70	Yellow Do.	Mature Ovaries.	1-32" Nil	
	II	7	16	0-114	35		..	Nil	Hoppers found on the rocks. Do. A few adults of new generation collected.
August ..	I	6	9	0-80	24	Yellow	Mature Ovaries.	Nil	
	II	6	12	0-84	23	..	..	Nil	
September ..	I	6	28	0-260	91	Some yellow Some Hyaline	..	Nil	
	II	6	57	0-406	141	Do. ..	..	Nil	Increase of Population at end of month. Forms with Pink or Mauve bases.
October ..	I	6	90	80-448	241	Lightly yellow blue.	..	Nil	One V-Stage hopper found near Nala-Kharan.
	II	7	256	40-1152	390	Do. ..	..	Nil	One III-Stage hopper in a field near Lak Baduk. A large increase of population after 28th October.
November ..	I	6	248	120-1560	688	Hyaline or light yellow with mauve or blue base.	Immature ..	Nil	
	II	5	98	200-780	436			Nil	

STATEMENT C-IV.
Results of Intensive Surveys—December 1935 to November 1936—Chachro Outpost.

Months	Fort- night.	No. of Surveys.	Total No. of locusts observ- ed.	Range of Population Density during Survey s.	Average population rate for fortnight.	Colour of hind- wings	Condition of Ovaries.	Rainfall.	Remarks.
December 1935 ..	I II	7 11	7 8	0-480 10-800	90 131	Slightly yellow .. ..	.. ..	Nil. Nil.	
January 1936 ..	I II	10 7	13 4	0-180 0-80	37 20	Slightly yellow .. ..	.. ..	Nil. Nil.	
February 1936 ..	I II	7 11	9 12	0-114 0-240	60 98	Slightly yellow to yellow. Slightly yellow and yellow.	.. ..	Nil. 0-07"	
March 1936 ..	I II	9 11	15 25	0-330 0-300	105 137	Slightly yellow and yellow. ..	.. ..	Nil. 0-08"	
April 1936 ..	I II	6 8	3 2	0-160 0-80	11 13	Yellow Yellow	.. ..	Nil. Nil.	
May 1936 ..	I II	10 14	2 8	0-60 0-120	7 25	Yellow Slightly yellow ..	.. ..	Nil. Nil.	
June 1936 ..	I II	11 10	18 15	0-610 0-192	143 96	Yellow Yellow	.. ..	Nil. 0 31"	Slightly pink or mauve at base.
July 1936 ..	I II	11 15	13 7	0-160 0-80	63 24	Yellow Yellow	.. ..	4-23" 0 12"	Red nutes found.
August 1936 ..	I II	12 11	34 215	0-180 680-3,600	152 1,651	Yellow Some yellow others hyaline.	Mature Yellow ones mature.	Nil. 0 06"	(11 hoppers found). New generation adults found from 10th August. (33 hoppers found).

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Month.	Fort- night.	No. of Surveys.	Total No. of locusts observed.	Range of population density during Survey.	Average population rate for fortnight.	Colour of hind- wings.	Condition of Ovaries.	Rainfall.	Remarks.
September 1930 ..	I	10	72	720-1,440	992	Ify lime or slightly yellow	..	1.25"	Red mites in most. (1 hopper found).
	II	9	47	120-3,000	1,013	yellow or slightly yellow	..	Nil	Red mites in most. (1 hopper found).
October 1930 ..	I	8	3	0-240	10	Slightly yellow	Immature	Nil	(11) hoppers found.
	II	0	1	0-30	0	Ify lime or slightly yellow	Do	Nil	(2) hoppers found.
November 1930 ..	I	13	1	..	1	..	..	1.25"	..
	II	11	Nil	Nil	Nil	..	..	14-15 in.	..

Month.	Fort- night.	No. of Surveys.	Total No. of locusts observ- ed.	Range of Population Density during Surveys.	Average Population Perc. for fortnight.	Colour of hind- wings.	Conditions of Ovaries.	Rainfall.	Remarks.
October 1936	I	10	68	0-1,000	378	Hyaline or slightly yellow. Some yellow.	Immature	Nil	(18 hoppers found).
	II	11	156	60-2,400	913	Hyaline or slightly yellow.	..	Nil	(20 hoppers found).
November 1936	I	11	117	60-1,600	656	Hyaline or slightly yellow.	..	0.84"	(4 hoppers found).
	II	10	199	120-2,000	815	Hyaline, yellow or slightly yellow.	Mostly immature	Nil	Red mites in many.

STATEMENT C-VI.

Results of Intensive Surveys—December 1935 to November 1936—Sardarshahr Outpost.

Month.	Fort- night.	No. of Surveys.	Total No. of locusts observed.	Range of Population Density during the surveys.	Average Population Rate for the fortnight.	Colour of hind- wings.	Condition of Ovaries.	Rank all.	Remarks.
December 1935 ..	I II	0 8	3 2	? 0-19	? 3	Slightly yellow ..	..	0-12" Nil.	
January 1936 ..	I II	8 8	Nil Nil	.. ..	.. ..	.. ..	.. ..	Nil 0-02"	
February 1936 ..	I II	6 9	3 1	0-159 0-60	53 7	Slightly yellow .. Yellow	.. ..	0-08" 0-84"	
March 1936 ..	I II	8 0	Nil Nil	.. ..	.. ..	.. ..	.. ..	0-06" 0-15"	
April 1936 ..	I II	7 7	Nil Nil	.. ..	.. ..	.. ..	.. ..	Nil Nil	
May 1936 ..	I II	0 8	Nil Nil	.. ..	.. ..	.. ..	.. ..	.. 0-10"	
June 1936 ..	I II	4 7	Nil 1	.. ?	.. ..	Slightly yellow ..	Immature ..	Nil 0-70"	
July 1936 ..	I II	8 7	Nil 1	.. 0-60	.. 8	Slightly yellow ..	..	0-02" Nil	
August 1936 ..	I II	6 9	2 35	0-60 0-210	10 120	Slightly yellow .. Hyaline, slightly yellow and yel- low.	.. ..	1-20" 1-46"	

Month.	Fort- night.	No. of surveys	Total No. of locusts observed.	Range of Population Density during the surveys.	Average Population rate for the fortnight.	Colour of hind- wings.	Condition of Ovaries.	Rainfall	Remarks.
September 1930 ..	I	9	0	0-180	39	Slightly yellow at d, flow.	..	0 11"	(4 hoppers found)
	II	8	Nil	..	..	..	..	0 11"	
October 1930 ..	I	12	2	0-240	40	Hyaline	..	Nil	(21 hoppers found)
	II	13	9	0-120	46	Hyaline	..	0-04"	
November 1930 ..	I	8	8	0-100	72	Hyaline or slightly yellow.	..	0 21"	Nil.
	II	11	7	0-240	55	Do.	..	..

STATEMENT D.

Details of Movements of the Locust Research Entomologist during 1936.

Serial No.	Month.	Duration of Visit.	Particulars and purpose.
1	January ..	14th to 25th January ..	To attend the Meeting of the Locust Committee at New Delhi on 20th and 21st January.
2	February-March	16th February to 19th March.	Periodical visit to Pasni; and a tour in the interior of Mekran to examine the areas of incipient swarming (23rd February to 4th March).
3	April ..	30th April	Periodical inspection visit to Ambagh.
4	May-June ..	24th May to 6th June ..	Periodical inspection visit to Pasni.
5	June ..	16th June	Inspection visit to Ambagh.
6	June-July ..	24th June to 4th July ..	Inspection visit to Chachro Outpost and a tour in the Thar area in Mithi Tq.
7	July-August ..	22nd July to 4th August	Inspection of the office of the Assistant at Barmer and of Nokh and Sardarshahr Outposts and a tour in the interior areas of Jaisalmer and Bilaner States.
8	August ..	9th to 16th August ..	Inspection of Pasni Station.
9	September ..	11th to 21st September	Inspection of Sardarshahr Outpost and a tour of survey in the interior of the Bilaner area to note the effect of the recent heavy rains on Locust breeding.
10	October ..	4th to 20th October ..	Periodical inspection of Pasni Station. Examination of the results of previous years.
11	November ..	7th November ..	Periodical visit to Ambagh Station.
12	December ..	2nd December ..	Visit to Ambagh Locust Research station to show the work in progress and also the nature of the locust breeding grounds to Sir John Russell, O.B.E., F.R.S., Expert Scientific Adviser to the Imperial Council of Agricultural Research.
<i>Visits paid by the Assistant Entomologist, Karachi (Dr. S. Mulherji) during the year.</i>			
1	February ..	10th—12th February ..	Visit to Ambagh Station.
2	March-April ..	26th March to 3rd April	Inspection of Chachro Outpost and visit to the Desert areas in the vicinity.
3	August ..	20th August	Visit of inspection to Ambagh.

STATEMENT E-1.
Rainfall Data for 1936.

Month.	Panjgur.	Mand.	Turbat.	Gwadar.	Pasni.	Ormara.	Bela.	Ambagh.	Karachi.	Chachro.	Barmer.	Nokh.	Sardar-shahr.
December 1935	..	0.38	..	0.31	0.33	..	0.03	..	..	..	..	0.10	0.12
January 1936	..	0.37	0.97	0.62	1.59	1.83	..	0.32	0.1	..	..	..	0.02
February 1936	..	0.95	0.58	0.60	0.83	2.59	1.03	0.65	0.5	0.07	0.05	0.15	0.62
March 1936	..	1.46	1.61	2.70	0.06	0.88	0.33	..	0.1	0.08	0.39	0.06	0.21
April 1936
May 1936	..	0.53	..	..	..	..	..	..	..	..	..	0.21	0.16
June 1936	0.07	0.38	0.7	0.27	1.00	0.31	0.70
July 1936	..	1.10	0.80	..	0.12	0.10	1.13	1.32	2.6	1.64	2.90	1.37	0.88
August 1936	0.06	1.30	16.36	2.71
September 1936	2.11	..	..	1.25	1.50	0.60	0.22
October 1936	0.04
November 1936	..	0.12	..	..	0.06	..	..	..	..	1.22	0.30	0.84	0.21
Total from December 1935 to November 1936.	5.41	3.09	3.96	4.23	3.89	5.10	4.70 upto Oct.	2.97	4.00	7.59	7.61	20.09	6.22

Rainfall Data for 1935.

Month.	Panigur.	Mand.	Turbat.	Gwadar.	Pasni.	Ormara.	Beka.	Ambagh.	Karachi.	Chachro.	Barnor.	Nokh.	Sardar-shahr.
December 1934	2-68	0-90	1-59	5-25	1-66	1-82	0-72	0-50	0-24	Nil	Nil	0-10	0-52
January 1935	1-10	3-01	2-72	4-81	6-74	3-05	0-79	0-92	0-74	0-41	0-92	Nil	1-30
February 1935	2-48	5-19	3-85	0-90	2-03	6-99	2-46	0-78	1-63	Nil	Nil	Nil	0-55
March 1935	Nil	Nil	0-20	Nil	Nil	Nil	Nil	Nil	0-7	Nil	Nil	Nil	0-56
April 1935	2-06	2-14	2-14	0-01	0-11	1-77	2-41	1-38	1-47	Nil	0-32	Nil	0-57
May 1935	0-08	0-44	Nil	Nil	Nil	Nil	0-20	Nil	Nil	Nil	0-03	Nil	Nil
June 1935	Nil	Nil	Nil	Nil	Nil	Nil	0-29	Nil	Nil	Nil	Nil	Nil	1-09
July 1935	Nil	Nil	Nil	Nil	Nil	Nil	0-48	0-38	0-39	8-18	5-67	6-22	6-53
August 1935	Nil	Nil	Nil	Nil	Nil	Nil	0-05	0-26	2-17	0-07	1-90	Nil	1-05
September 1935	Nil	Nil	Nil	Nil	Nil	Nil	0-19	0-05	Nil	6-19	1-60	0-59	3-39
October 1935	Nil	Nil	Nil	Nil	Nil	Nil	0-03	0-06	A. duzle. Nil	0-50	Nil	0-04	0-10
November 1935	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Total	8-40	11-71	10-59	10-97	11-54	13-63	7-61	4-14	5-13	12-03	10-14	6-94	15-71

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Summary E-3. Rainfall Data for 1971.

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STATEMENT No. F. (II)—Ambagh.

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STATEMENT NO.

Monthly Data in regard to various Meteorological Observations taken at Ambagh

Month.	Temperature.				Humidity.		Soil			
	Screen.		Open air.		Screen.		Surface.		2' Deep.	
	Av. Daily C	Range	Av. Daily C.	Range	Av. Daily.	Range.	Av. Daily C.	Range.	Av. Daily C.	Range.
Dec. 35 .	10 67	±7 83	20 15	±7 85	64 70	±10 20	23 33	±13 1	21 51	±6 70
Jan. 36 ..	16 81	±8 10	17 05	±7 75	55 80	±17 10	20 03	±12 60	18 50	±6 70
Feb. ..	10 75	±6 64	20 25	±6 95	70 85	±20 65	25 06	±13 63	23 25	±8 15
March ..	21 67	±7 56	22 10	±7 50	65 70	±21 20	20 75	±11 30	26 05	±8 85
April ..	26 42	±6 76	26 94	±6 98	69 91	±21 20	37 06	±10 34	33 14	±10 09
May ..	29 29	±4 45	29 53	±4 63	80 00	±13 57	40 13	±14 23	37 68	±8 05
June ..	30 88	±3 42	30 83	±3 33	80 10	±10 25	40 42	±12 70	38 03	±6 84
July ..	29 62	±2 85	29 79	±2 65	86 00	±6 00	37 72	±8 08	35 23	±5 31
August ..	28 42	±3 08	28 68	±3 10	81 50	±9 07	39 05	±10 50	36 37	±6 88
Sep ..	27 79	±4 22	28 21	±4 11	78 14	±13 94	38 38	±11 68	35 25	±8 11
Oct. ..	26 09	±5 87	26 19	±5 72	83 13	±13 56	35 50	±14 82	32 25	±8 08
Nov. ..	22 1	±8 96	30 01	±9 24	67 26	±13 17	29 25	±17 02	26 65	±9 01
Average for the year.	24 90	±5 82	25 89	±5 82	73 84	±14 68	32 89	±13 35	30 32	±7 88

F. (II)—AMBAGH.

during a period of 12 months from December 1935 to November 1936.

temperature.				Evaporation		Wind.	Variation of Baromet.	Remarks.
4° Dep.		6° Dep.		Av. Daily.		Max. Vel per Hour.	Pressures.	
Av. Daily C.	Range.	Av. Daily C.	Range.	Sun.	Shade			
21.65	± 3.45	22.44	± 1.44	8.21	7.00	9.51	30.07—30.52	Nd.
18.15	± 1.07	18.81	± 1.74	9.03	9.75	9.60	30.26—30.52	0.32°
22.35	± 3.75	22.40	± 1.67	7.70	6.70	11.60	30.00—30.18	0.03°
25.15	± 5.07	25.80	± 3.61	10.05	9.01	12.50	30.10—30.45	Nd.
31.26	± 4.65	31.21	± 3.26	10.60	9.00	13.31	29.94—30.22	Nd.
36.70	± 0.50	34.59	± 2.17	9.00	7.32	11.22	29.73—30.08	Nd.
37.65	± 5.70	34.26	± 0.28	12.51	8.28	17.6	29.64—29.68	0.38°
34.01	± 4.59	34.07	± 2.52	10.10	6.17	11.94	29.63—29.95	1.32°
30.29	± 7.13	31.19	± 2.37	6.52	5.81	12.16	29.75—29.79	Nd.
35.40	± 7.82	33.19	± 2.75	6.08	6.32	9.40	29.81—30.11	Nd.
31.08	± 7.42	30.76	± 2.09	6.18	4.65	11.20	30.01—30.38	Nd.
24.75	± 6.70	24.75	± 3.13	9.76	8.13	..	30.16—30.39	Nd.
20.01	± 5.46	30.67	± 2.32	9.12	7.29	..	..	2.07° Total for the year.

STATEMENT NO. F-III.

Monthly Data in regard to various Meteorological Observations at the Observation Post, Chachio during a period of 12 month: from December 1935 to November 1936.

Month.	Temperature.			Humidity.		Evaporation.		Rain-fall.	Wind Direction.
	Average Daily.	Range.	Highest Maximum.	Lowest Minimum.	Average Daily.	Range.	Sun.	Shade.	
December 1935	18.00	±0.0	32.6	3.0	42.0	±21.0	11.5	8.5	From East and North east.
January 1936	15.75	±9.5	28.3	2.3	41.5	±17.5	10.0	7.8	From North and East.
February	20.01	±8.6	31.0	5.0	50.5	±27.5	11.9	9.0	From East, North-east and West.
March	21.70	±9.2	39.8	7.3	30.5	±22.5	21.1	14.0	From North-east.
April	20.90	±0.7	42.8	16.5	40.0	±27.0	31.4	22.2	From South-west.
May	33.00	±8.6	47.1	22.2	53.7	±29.4	31.5	21.1	From South-west.
June	33.0	±0.3	42.6	25.0	03.5	±20.5	33.3	21.5	From South-west.
July	30.29	±4.7	39.1	23.7	70.5	±18.5	19.1	12.8	From South-west
August	30.22	±5.1	38.1	22.2	61.5	±17.5	18.3	11.0	From South-west.
September	30.11	±0.3	42.4	21.1	65.5	±22.5	19.3	13.3	From South-west.
October	28.67	±0.3	40.7	16.7	70.5	±10.5	21.7	15.5	From South-west and West.
November	23.00	±7.8	37.0	8.0	49.7	±18.8	15.1	11.2	..
Average for the year	26.56	±7.9	38.6	11.3	55.0	±20.9	20.8	11.2	7.89" Total Rainfall.

STATEMENT NO. F-IV.

Monthly Data in regard to various Meteorological Observations; taken at the Observation Post Nohk during a period of twelve months from December 1935 to November 1936.

Month.	Temperature.			Humidity.		Evaporation.		Rain-fall.	Wind Direction.
	Average Daily.	Range.	Highest Maximum.	Lower Variation.	Average Daily.	Range.	8 in.	Shad.	
December 1935	15.72	±10.2	31.4	0.72	39.0	±30.0	12.4	9.5	0-10°
January 1936	13.93	±9.4	27.2	-0.5	39.0	±17.1	11.68	9.5	..
February	18.12	±9.2	31.7	2.4	45.4	±23.4	13.1	10.9	0-17°
March	21.23	±10.0	30.4	2.5	39.5	±16.5	..	..	0-20°
April	29.05	±9.8	44.2	11.5	30.0	±14.0	31.0	21.5	..
May	33.22	±5.4	48.1	22.5	37.0	±18.0	30.5	23.5	0-21°
June	34.17	±5.4	43.7	23.6	51.5	±19.5	37.5	21.5	0-31°
July	32.55	±5.2	41.1	24.4	59.5	±19.9	27.94	18.4	1-37°
August	31.63	±4.6	41.1	22.2	69.0	±18.0	19.0	11.3	10-35°
September	29.56	±6.4	40.9	15.4	60.0	±24.0	17.8	10.6	0-60°
October	27.73	±6.9	40.0	14.3	62.5	±22.5	20.3	12.0	..
November	29.38	±9.5	39.2	6.2	51.5	±23.4	12.38	7.09	0-51°
Average for the year	26.0	±8.9	51.0	12.6	47.2	±19.4	22.1	14.5	Total for the year 29.03°

STATEMENT No. F-V.

Monthly Data in regard to various Meteorological Observations taken at the Observation Post, Sardarshahr during a period of 12 months from December 1935 to November 1936.

Month.	Temperature.				Humidity.		Evaporation.		Rain-fall.	Wind Direction.
	Average Daily.	Range.	Highest Maximum.	Lowest Minimum.	Average Daily.	Range.	Sun.	Shade.		
December 1935	15.19	±9.03	30.3	1.0	49.5	±20.5	9.7	8.1	0.19"	
January 1936	11.86	±9.25	21.0	-0.1	40.5	±20.5	11.7	8.5	0.02"	
February 1936	17.53	±8.60	30.0	3.2	42.5	±24.5	11.7	11.2	0.03"	
March 1936	20.07	±8.81	38.3	5.1	41.0	±21.0	19.7	16.3	0.21"	
April 1936	28.08	±9.08	42.0	11.7	22.5	±14.5	30.1	25.9	..	
May 1936	30.33	±8.05	47.7	22.2	28.5	±11.5	50.2	31.2	0.16"	From South and South-west.
June 1936	33.07	±5.07	43.9	22.8	47.0	±15.0	60.1	31.9	0.70"	From North-west.
July 1936	33.11	±5.4	42.2	23.3	53.5	±17.5	43.6	23.9	0.88"	From North-east.
August 1936	31.14	±4.02	42.8	23.3	62.0	±15.0	25.9	14.5	2.71"	
September 1936	30.42	±6.02	39.1	20.3	57.0	±23.0	20.1	12.9	0.25"	From North-east and North-west.
October 1936	27.06	±6.2	39.3	14.7	36.0	±10.0	25.2	15.6	0.04"	From South-west.
November 1936	19.73	±6.13	34.0	6.2	38.0	±18.7	17.3	12.0	0.21"	
Average for the year	25.45	±7.87	38.0	12.0	43.2	±18.4	27.4	17.0	6.22" Total Rainfall	

STATEMENT G.-I.

Experiments on the influence of the quality of food on Sex-Maturity of Schistocerca.
1935 Summer Season—Parsi.

Particulars of Food.	Cage No.	Date of final moult.	First appearance of yellow colour in wings.		First Oviposition.			No. of egg-layings.	Duration of life of female.	General remarks.
			Date.	Time taken (in days).	Date.	Length of period of Sex-Maturation (in days).				
<i>A.—Murrand under different conditions.</i>										
Fresh Murrand ..	B ₉ ..	22-25-V ..	Not noted	..	27-VI ..	33—36	..	..	3 pairs were kept in one cage so that the egg-masses laid by each cannot be discriminated.
Do. ..	B ₁₁ ..	29-V ..	15-VI ..	16	3-VII ..	35	..	..	Do.
Do. ..	C ₁ ..	30-VI ..	19-VII ..	19	10-VIII ..	40	..	..	Experiment discontinued after first egg-laying.
Do. ..	C ₆ ..	8-VII ..	26-VII ..	18	14-VIII ..	37	3	66	Died on 12th September 1935.	
Do. ..	C ₉ ..	30-VII ..	14-VIII ..	15	29-VIII ..	30	4	67	Died on 5th October 1935.	
Do. ..	C ₁₇ ..	9-VIII ..	29-VIII ..	20	12-IX ..	34	1	38	Died on 16th September 1935.	
Average	17.6	..	35		

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Particulars of Food.	Cage No.	Date of final moult.	First appearance of yellow colour in wings.		First Oviposition.		No. of egg-layings.	Duration of life of female. ¹	General remarks.
			Date.	Time taken (in days).	Date.	Length of period of Sex-maturation (in days).			
Old Murrend	B ₁₀ ..	22-25-V ..	Not noted	..	8-VII ..	41-47	..	..	Probably one eggmass only.
Do.	B ₁₂ ..	23-30-V ..	Not noted	..	8-VII ..	40-42	..	..	Do.
Do.	C ₈ ..	1-VII ..	22-VII ..	21	6-VIII ..	36	..	..	Female kept on fresh murrend for a week before setting up the experiment ; discontinued after one egg-laying.
Do.	C ₇ ..	10-VII ..	6-VIII ..	27	29-VIII ..	50	3	76	Died on 24th September 1935.
Do.	C ₁₀ ..	31-VII ..	26-VIII ..	26	No oviposition		..	72	Killed by a centipede on 11th October 1935. Ovaries not dissected out.
Do.	C ₁₂ ..	9-VIII ..	5-IX ..	27	No oviposition		..	70	Died on 18th October 1935 ; Ovaries half mature.
Average ..	..	..	..	25-25	..	43-1	..	..
Old Murrend	C ₃ ..	2-VII ..	26-VII ..	24	30-VIII ..	59	1	59	Died on 30th August 1935.
Wetted.	C ₄ ..	7-VII ..	30-VII ..	23	30-VIII ..	54	2	85	Died on 30th September 1935.
Do.	C ₁₁ ..	1-VIII ..	12-IX ..	42	..	..	..	..	Found missing : 16th September 1935.

Do.	..	C ₂₃ ..	22-VIII ..	9-IX ..	18	13-X ..	52	1	52	Died on 13th October 1935.
Average ..	..	..	..	..	20.75	..	55	..	..
Old Murand with Moist Atmosphere.	..	B ₁₃ ..	31.V ..	24.VI ..	24	13-VII ..	45	..	..	3 pairs in one cage, so that egg-laying could not be discontinued.
Do.	..	B ₁₄ ..	31.V ..	24.VI ..	24	17-VII ..	47	..	..	Female flew away on 29th August 1935.
Do.	..	C ₁₃ ..	2-VIII ..	22-VIII ..	20	..	..	..	..	Female flew away on 24th September 1935.
Do.	..	C ₁₅ (1)	19-VIII ..	18-IX ..	26	..	..	..	37	Killed by centipede : 21st October 1935.
Do.	..	C ₁₄ ..	14-VIII ..	9-IX ..	26	23-IX ..	45	3	58	Do.
Do.	..	C ₂₁ ..	22-VIII ..	9-IX ..	18	4-X ..	43	1	..	
Average ..	..	..	..	..	23	..	45	..	..
B.—Different food-plants.										
Jowari	..	C ₂₅ ..	10-VIII ..	27-VIII ..	18	4-IX ..	25	6	58	Died on 7th October 1935. It had partially mature eggs at time of death; laid eggs every 5th day.
	..	C ₁₄ ..	13-VIII ..	29-VIII ..	16	3-IX ..	21	2	36	Died on 18th September 1935.
	..	C ₁₅ ..	18-VIII ..	1-IX ..	19	2-IX ..	20	3	37	Died on 10th September 1935.
	..	C ₁₆ ..	20-VIII ..	6-IX ..	14	12-IX ..	23	3	43	Died on 2nd October 1935.
Average ..	..	..	..	..	16.7	..	22.25	..	..

Particulars of Pool.	Circ. No.	Date of issue.	Periods previous to previous issue in weeks.		First Order (in %).		No. of packages in %.	Period of effect of issue.	Comments.
			Issue.	Time interval.	Issue.	Period of effect of issue.			
Kanduk	C ₁	4.VIII ..	16.VIII ..	12	10.VIII ..	27	..	..	Experiments continued after 15. IX 1933.
	C ₂	6.VIII ..	1.VIX ..	26	22.IX ..	67	2	25	Dead on 10th Nov 1933.
	C ₃	8.VIII ..	23.VIII ..	23	6.IX ..	31	3	21	Dead on 20th Nov 1933.
	C ₄	9.VIII ..	1.IX ..	23	15.IX ..	50	2	..	Dead on 20th Nov 1933.
Average	..	..	..	21.5	..	28.5	..	..	..
Dallboy	C ₅	25.VIII ..	17.VIII ..	29	4.IX ..	43	1	73	Dead on 15th October 1933.
	C ₆	27.VIII ..	22.IX ..	25	19.X ..	20	1	76	Dead on 15th November 1933.
	C ₇	10.VIII ..	3.IX ..	22	..	..	..	..	Killed by scorpion on 20th November 1933.
	C ₈	25.VIII ..	22.IX ..	29	16.X ..	52	1	63	Dead on 22-1 November 1933.
Average	..	..	..	24.5	..	40	..	..	..

Kharzan	..	C ₁₇ ..	5-VI ..	Not noted	..	20-VIII ..	70	2	91	Died on 4th September 1935; had half-developed eggs.
		C ₁₈ ..	6-VIII ..	22-VIII ..	16	..	..	..	54	Died on 29th September 1935; had immature ovaries.
		C ₁₉ ..	7-VIII ..	25-29-VIII	22	19-IX ..	43	1	60	Died on 6th October 1935.
		C ₂₀ ..	22-VIII ..	24-IX ..	33	..	..	..	65	Died on 22nd November 1935.
Average	..	..	..	..	23.66	..	..	..	59.5	

STATEMENT G-II.
Experiments on the influence of the quality of food on the Sex-Maturity of Schistocerca.
 1935-36 Autumn and Winter Season—Pasin.

Food plant.	Cage No.	Date of final moult.	First appearance of yellow colour in wings.		First Oviposition.		No. of egg-laying.	Total duration of life of female (days).	General remarks.
			Date.	Time taken (in days).	Date.	Length of period of sex-maturation (days).			
<i>A.—Murrant under different condition.</i> Fresh Murrant ..	C ₁₆	4-9-35	18-9-35	14	1-10-35	27	5	64	Died on 7th November 1935.
	C ₁₇	5-9-35	24-9-35	19	12-10-35	37	3	57	Died on 21st November 1935.
	C ₁₈	17-9-35	3-10-35	16	15-10-35	28	7	76	Died on 2nd December 1935. Had fully mature eggs.
	C ₁₉	14-10-35	29-10-35	15	6-12-35	53	1	85	Died on 7th January 1936. Had half-mature eggs.
	G ₁₂	1-10-35	20-10-35	19	6-12-35	66	3	121	Female died on 30th January 1936.
	C ₁₄	10-10-35	15-11-35	30	No egg-laying.	Over 75	..	Over 75	Female found missing on 30th December 1935.
Average ..	..	..	..	18.8	..	Over 47.7	..	Over 79.8	

Old Murrend	C ₃₉	18-9-35	12-10-35	24	No egg-laying.	Over 86	..	86	Female died on 13th December 1935. Had immature eggs.
	C ₈₈	9-10-35	2-11-35	24	Do.	Over 94	..	94	Female died on 11th January 1936.
Average	..	..	..	24	..	Over 90	..	90	
Old Murrend (Wetted)	C _{111A}	18-9-35	5-10-35	17	28-10-35	40	3	57	Died on 14th November 1935.
	C ₁₀	19-9-35	2-11-35	43	23-11-35	65	1	83	Female died on 11th December 1935.
Average	..	..	..	30	..	32.5	..	70	
Old Murrend (with moist atmosphere).	C _{112A}	25-9-35	12-10-35	17	3-12-35	69	1	90	Died on 24th December 1935.
	C ₁₂	12-9-35	3-10-35	21	4-11-35	53	2	Over 92	Found missing on 13th December 1935.
	C ₁₀	25-9-35	20-10-35	25	No egg-laying.	Over 121	..	121	Died on 24th January 1936. No egg-laying.
Average	..	..	..	21		Over 81	..	Over 10	

Food plant.	Cage No.	Date of final moult.	First appearance of yellow colour in wings.		First Oviposition.		No. of egg-layings.	Total duration of life of female (days).	General remarks.
			Date.	Time taken (in days).	Date.	Length of period of sex maturation (days).			
B.— <i>Different food plants.</i> Jowari ..	C ₂₄	4-9-35	16-9-35	12	30-9-35	26	4	54	Died on 28th October 1935.
	C ₂₅	4-9-35	18-9-35	14	2-10-35	28	4	58	Died on 1st November 1935.
	C ₂₆	18-9-35	3-10-35	15	14-11-35	57	4	91	Died on 18th December 1935.
	C ₂₇	19-9-35	3-10-35	14	17-10-35	28	3	56	Died on 14th November 1935. Had fully mature eggs.
	C ₂₇	23-9-35	9-10-35	10	2-12-35	70	2	106	Died on 7th January 1936. Had fully mature eggs.
	C ₂₈	29-9-35	9-10-35	10	21-11-35	53	3	90	Died on 28th December 1935. Had fully mature eggs.
	C ₂₈	9-10-35	24-10-35	15	1-12-35	53	1	7	Female found missing on 11th January 1936.
	Average ..	..	..	13.7	..	45.0	..	51.3	
Kulliohk ..	C ₂₉	17-9-35	24-11-35	68	No egg-laying.	Over 102	..	102	Died on 28th December 1935. Had half mature eggs.

	C ₁₇	10-10-35	..	..	Do.	Over 98	..	98	Died on 16th January 1936. Wings still colourless. No eggs laid.
Average ..	..	..	..	68	..	Over 100	..	100	
Baliboor ..	C ₁₆	19-9-35	20-10-35	31	4-12-35	76	2	114	Died on 11th January 1936.
	C ₁₃	3-10-35	24-11-35	52	12-2-36	132	2	151	Female died on 2nd March 1936.
Average ..	..	..	..	41.5	..	104	..	132.5	
Kharzan ..	C ₁₄	19-9-35	2-11-35	44	No egg-laying.	Over 78	..	78	Died on 6th December 1935. Had half mature eggs.
	C ₁₀	10-10-35	3-11-35	26	21-12-35	72	1	89	Female died on 7th January 1936.
Average	35	..	Over 75	..	88.5	

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STATEMENT G-III.
Experiments on the influence of the quality of food on the Sex-Maturity of Schistocerca.
 1936 Summer Season.

Particulars of food.	Cage No.	Date of moulting into adult.	First appearance of yellow colour in wings.		First Oviposition.		No. of egg-layings.	Total duration of adult life of female (days).	General Remarks.
			Date.	Time taken (in days).	Date.	Length of period of sex maturation (in days).			
Fresh Murrand ..	C ₁	29-4-36	9-5-36	10	30-5-36	31	2	50	Died on 24th June 1936. Had no eggs.
	C ₂	17-5-36	5-6-36	19	28-6-36	42	7	87	Died on 12th August 1936.
	C ₁₃	20-5-36	5-6-36	10	1-7-36	42	2	65	Died on 24th July 1936.
	C ₁₂	28-5-36	15-6-36	18	12-7-36	45	5	83	Died on 10th August 1936. No eggs.
	C ₃₁	24-5-36	9-9-36	16	18-9-36	25	6	66	Died on 19th October 1936.
Average ..	..	..	..	16	..	37	4.4	71.4	
Old Murrand ..	C ₄	18-5-36	5-6-36	18	14-7-36	57	1	58	Died on 15th July 1936.
	C ₁₈	23-5-36	5-6-36	13	14-7-36	52	1	54	Died on 16th July 1936.

	C ₁₃	20-5-36	19-6-36	21	..	No egg-laying (over 53 days).	..	53	Died on 21st July 1936.
Average	..	..	..	17.3	Over 54	..	0.6	55 66	
Kulichek	C ₃	2-6-36	24-6-36	22	6-7-36	31	2	42	Died on 14th July 1936.
	C ₁₀	18-5-36	6-7-36	49	..	No egg-laying (over 93).	..	93	Died on 19th August 1936. No egg-laying, in spite of copulations. Not normal.
	C ₁₇	24-5-36	29-6-36	36	20-7-36	66	2	Over 85	Found missing on 17th August 1936.
	C ₂₁	29-5-36	24-6-36	26	31-7-36	83	1	78	Died on 15th August 1936.
	..	..	..	33.2	..	64	1.4	74.5	
Ballboor	C ₁	5-5-36	28-5-36	23	24-6-36	50	2	74	Died on 18th July 1936. No eggs.
	C ₁₁	18-5-36	9-6-36	22	13-8-36	87	2	111	Died on 6th September 1936. No eggs.
	C ₁₆	25-5-36	15-6-36	21	4-7-36	40	2	64	Died on 28th July 1936. No eggs.
	C ₂₁	30-5-36	16-6-36	10	..	No egg-laying (over 75).	..	75	Died on 13th August 1936.
	..	..	..	20.5	..	63	1.5	81	
Average	..	..	..	20.5	..	63	1.5	81	

Particulars of food.	Cage No.	Date of moulting into adult.	First appearance of yellow colour in wings.		First Oviposition.		No. of egg-layings.	Total duration of life adult of female (days).	General Remarks.
			Date.	Time taken (in days)	Date	Length of period of sex maturation (in days).			
Kharan ..	C ₁₂	18-5-36	15-6-36	28	12-7-36	55	1	57	Died on 14th July 1936.
	C ₁₃	3-6-36	29-6-36	26	20-7-36	47	1	78	Died on 12th August 1936.
	Average ..	..	..	27	..	51.0	1	67.5	
Maize ..	C ₈	10-5-36	23-5-36	13	8-6-36	29	5	70	Died on 14th July 1936.
	C ₁₅	30-5-36	9-6-36	10	18-6-36	19	6	48	Died on 17th July 1936.
	C ₁₁	28-5-36	9-6-36	12	14-7-36	47	2	50	Died on 23rd July 1936.
	C ₁₆	13-8-36	30-8-36	17	20-9-36	44	2	68	Died on 20th October 1936.
	Average ..	/ ..	..	13	..	36	3.7	60.5	
Jowari Plant ..	C ₁₄	5-6-36	6-7-36	31	7-7-36	32	..	..	Flew away on 8th July 1936.
	C ₁₇	3-6-36	6-7-36	33	14-7-36	41	1	69	Died on 11th August 1936.

Average	C _{2s}	3-6-36	24-6-36	21	0-7-36	33	3	61	Died on 4th August 1936.
	C _{3s}	23-8-36	15-9-36	23	30-9-36	38	3	53	Died on 15th October 1936.
Jowari Seedling	..	..	.	27	.	36	1	61	
	C ₄	12-5-36	23-5-36	10	19-6-36	37	6	76	Died on 28th July 1936.
	C _{1t}	20-5-36	6-6-36	16	19-6-36	29	6	31	Found missing on 10th July 1936.
	C _{2t}	28-5-36	19-6-36	22	4-7-36	37	1	75	Died on 11th August 1936.
Average	..	..	..	16	..	34	5.3	67.3	

STATEMENT G.-IV.

Experiments on the influence of the quality of food on sex-maturity of Schistocerca at Ambagh.

Particulars of Food.	Cage No	Date of Final moult	First appearance of yellow on wings		First oviposition		General Remarks.
			Date.	Time taken in (days)	Date	Length of period of Sex Maturity (in days).	
Fresh Khatran ..	(1)	22-10-35	1935 Autumn Season—Ambagh 8-1-36 78 . .				Died on 22nd February 1936
Do ..	(2)	28-10-35	..	.	.	.	Died on 24th February 1936. Yellow colour had not appeared.
Average ..	..	.		78	.	..	
Fresh Baliboor ..	(3)	13-10-35	12-11-35	30	.	..	Found missing on 24th November 1935
Do ..	(4)	30-10-35	28-1-36	89	28-11-35	120	Discontinued after first oviposition.
Average ..	.	.	.	59	.	120	
Fresh Maznog ..	(5)	21-10-35	.	..	..	.	Both male and female developed dark pink colour in body and wings. Male ate up the female on 2nd November 1935
Summer Season 1936							
Fresh Khatran ..	(6)	10-5-36	26-5-36	16	23-6-36	44	♀ Died on 9th July 1936.
Do ..	(7)	27-5-36	16-6-36	20	..	..	♀ escaped while feeding
Do ..	(8)	19-6-36	Not	noted	14-7-36	26	Discontinued after 1st oviposition.
Average ..	..	..	..	18	..	35	
Semidry Khatran ..	(9)	27-5-36	..	..	..	..	Pink colour developed on the body: ♀ ate up the male on 2nd June; then it also died on 8th June.
Fresh Baliboor ..	(10)	10-5-36	26-5-36	16	23-7-36	71	Discontinued after 1st oviposition.
Do ..	(11)	18-6-36	Not	noted	15-7-36	27	
Average ..	..	.	..	16	..	50	

STATEMENT G.-IV—*contd.*

Particulars of Food	Cage No	Date of Final moult.	First appearance of yellow in wings		First oviposition.		General Remarks
			Date.	Time taken (in days)	Date	Length of period of Sex Maturity (in days)	
Summer Season 1936.							
Fresh Marung	(12)	10.5.36	..			..	Body found pink wings also became pink on 4th June. ♀ died on 4th July.
Do	(13)	27.5.36	.	.	..	.	Wings found pink on 25th July. Discontinued on 29th June
Do	(14)	18.6.36	..	.	.	..	♀ died on 28th June 1936
Jowari Seedling and Leaves	(15)	10.5.36	17.5.36	7	8.6.36	20	♀ died on 20th June Eggs laid on 23rd June and 28th June
Do.	(16)	18.5.36	Not noted		19.7.36	21	
Average	..	..	..	7	..	25	
Autumn Season 1936							
Very Young Fresh Khazran.	(17)	21.9.36	15.10.36	21	.	..	Under observation.
Average	..	..	..	21	..	..
Comparatively Old Khazran	(18)	21.9.36	10.10.36	16	2.11.36	30	Still under observation.
Average	..	..	..	16	.	30	
Fresh Marung	(19)	24.9.36	..	..	..	..	♀ Died on 8th October 1936. ♀ under observation.
Average	..	..	..	0	..	..
Fresh Murrand	(20)	25.9.36	10.10.36	25	..	..	Under observation.
Average	..	..	..	25	..	..

STATEMENT G.-V.
Results of experiments to find out the amount (in gms) of dried faecal matter excreted by an adult female per day on different food-plants.

Food-plant.	Ref. No.	Date of starting the experiment (date of fledging of adult).	Total weight of excreta passed (gms).	Total length of life of female (in days).	Average dry weight of excreta per day (gms)	Dry weight of total excreta passed before appearance of yellow colour in hind wings (gms)	Time taken before appearance of yellow colour in hind wings (in days).	Dry weight of total excreta passed before first egg-laying (gms).	Date when the experiment ended by the death of the female.
Fresh Murrind..	A ₁	4-9-36	10.591	46	0.2307	4.352	17	10.003	21-10-36*
Do.	A ₂	7-9-36	8.538	44	0.194	5.731	18	Died before egg-laying ..	21-10-36
Average ..	..	..	..	..	0.212	5.042	..	10.003	..
Old Murrind ..	A ₂	4-9-36	11.114	47	0.236	9.976	12	Died before egg-laying ..	21-10-36
Do.	A ₃	2-10-36	5.302	19	0.279	Died before appearance of yellow colour.	..	Do.	21-10-36
Average ..	..	..	..	..	0.258	9.976	..	..	..
Baltboor ..	A ₂	5-9-36	8.191	35	0.242	7.041	27	Died before egg-laying ..	21-10-36
Do.	A ₁₀	2-10-36	1.498	19	0.231	4.037	18	Do.	21-10-36
Average ..	..	..	..	..	0.247	5.517	..	..	..
Kulliruk ..	A ₄	5-9-36	0.065	73	0.159	0.065	38	Died before egg laying ..	14-10-36

Maize	..	A ₅	2-10-36	2-531	19	0-131	1-606	14	Died before egg-laying ..	21-10-36
Do.	..	A ₅ ^a	22-10-36	1-374	15	0-092	1-186	13	Do.	7-11-36
Average	..	..	..	..	..	0-113	1-306	..	..	..
Jowari plant	..	A ₆	7-9-36	0-065	14	0-047	Died before appearance of yellow colour.	..	Died before egg-laying ..	22-9-36
Do.	..	A ₆ ^a	2-10-36	2-320	19	0-122	Do. ..	..	Do.	21-10-36
Average	..	..	..	..	..	0-085	..	..	..	..
Kharzan	..	A ₇	7-9-36	8-538	44	0-194	5-731	27	Died before egg-laying ..	21-10-36

* Mostly the locusts died on account of the dry hot 'Gorich' wind that blew on 21st October 1936 at Panni.

ME53HCAR

STATEMENT H.-I.

Results of experiments to determine the amount (in gms) of dried faecal matter excreted per hopper per day in different stages and on different food-plants.

Food-plant	Ref. No of experiment	Date of starting experiment.	Average dry weight (in gms) of faeces excreted per day by individual hoppers in various stages										Total duration of nymphal life (hatching to fledging) (in days).	Date when the experiment ended.	Remarks
			I		II		III		IV		V				
			No. of hoppers.	Weight of faeces.	No. of hoppers.	Weight of faeces.	No. of hoppers.	Weight of faeces.	No. of hoppers.	Weight of faeces.	No. of hoppers.	Weight of faeces.			
Fresh Viburnd	W ₁	14.7.36	24-10	0.0054	10-10	0.0088	10-7	0.0428	7	0.1016	7	0.1820	60-65	7.9.37	One extra moult in all hoppers. No extra moult.
	W ₂	18.8.36	16-14	0.0072	11-11	0.0171	11-10	0.0514	10	0.0943	10	0.1671	42-60	6.10.36	No extra moult.
	W ₁₅	5.9.36	16-1	0.0062	1	0.0101	.	..	..	..	..	..	..	10.9.36	Hoppers died.
Average	..	..	..	0.0063	..	0.0153	.	0.0480	..	0.0904	..	0.1700	..	..	..
	W ₂	14.7.36	24-12	0.0082	12-8	0.0165	8-6	0.0550	6-5	0.1210	5	0.1862	42-55	7.9.36	One extra moult in all hoppers.
	W ₆	20.8.36	27-14	0.0066	14-12	0.0184	12-0	0.0482	6	0.1231	0	0.1042	50-58	10.10.36	
Average	W ₁₆	5.9.36	20-0	0.0082	..	.	.	.	..	.	.	..	..	14.9.36	Hoppers died.
	..	..	..	0.0077	..	0.0174	..	0.0610	.	0.1250	..	0.1807	..	..	..
	W ₂	18.7.36	31-1	0.0038	1	0.0076	.	.	..	.	.	.	..	4.8.36	None reached adult stage.
Average	W ₁₆	21.8.36	26-1	0.0040	1	0.0077	..	..	..	..	..	..	..	13.9.36	Do.
	W ₁₇	7.9.36	20-0	0.0034	..	.	.	.	..	..	..	.	.	20.9.36	Do.
	..	..	..	0.0017	..	0.0076	.	..	..	..	..	..	..	..	..

[illegible]

STATEMENT

Showing the results of rearings of Hoppers fed on different food-plants at Ambagh

(MR. R. N.

Food plant.	Cage No	Date of Hatching	Date of 1 moult	No of stripes in early II stage.	Date of II moult	Stripes in in early III stage
Tender Kharzan	A 1	20 4 36	..	..	..	..
	A 2	18 5 36	..	..	..	..
	A 3	17 6 36	24 6 36	..	..	..
	A 4	26 7 36	1 8 36	..	27 8 36	..
	A 5	2 8 36	12 8 36	.	2 9 36	..
	A 6	13 9 36	20 9 36	2	26 9 36	3
	A 7	13 9 36	21 9 36	2	27 9 36	3
	A 8	23 9 36	30 9 36	2	7 10 36	3
	A 9	23 9 36	2 10 36	2	9 10 36	3
	A 10	16 10 36	27 10 36	2	3 11 36	3
	A 11	16 10 36	25 10 36	2	31 10 36	3
	A 12	16 10 36	26 10 36	2	2 11 36	3
Comparatively Old Kharzan .	B 1	20 4 36	.	..	Not noted	
	B 2	17 6 36	25 6 36	.	Do	..
	B 3	17 6 36	24 6 36	..	Do	..
	B 4	3 7 36	10 7 36	..	15 7 36	..
	B 5	25 7 36	3 8 36	..	9 8 36	.
	B 6	13 9 36	23 9 36	2	3 10 36	3
	B 7	23 9 36	2 10 36	2	9 10 36	3
	B 8	23 9 36	3 10 36	2	12 10 36	3
Shoots of Murrond .	C 1	13 9 36	20 9 36	2	27 9 36	3
	C 2	13 9 36	20 9 36	2	26 9 36	3
	C 3	23 9 36	2 10 36	2	10 10 36	3
	C 4	23 9 36	30 9 36	2	7 10 36	3
	C 5	24 9 36	5 10 36	2	10 10 36	3
	C 6	16 10 36	26 10 36	2	2 11 36	3
	C 7	16 10 36	24 10 36	2	3 11 36	3
	C 8	16 10 36	23 10 36	2	30 10 36	3

H-II.

with notes on the development of eyestripes in *Hoppers*.

BATRA.)

Date of extra II moult.	Stripes in early III stage	Date of III moult	Stripes in early IV stage.	Date of IV moult.	Stripes in early V stage	Date of V moult	Stripes in early adult stage	Total larval period
..	..	..	..	..	..	27-5-36	..	37
..	..	..	..	..	..	21-6-36	..	37
..	..	10-7-36	..	15-7-36	..	28-7-36	..	39
..	..	14-8-36	..	25-8-36	..	5-9-36	..	41
..	..	9-9-36	..	17-9-36	..	30-9-36	..	56
..	..	3-10-36	4	10-10-36	6	22-10-36	6	70
..	..	4-10-36	4	12-10-36	6	26-10-36	6	43
11-10-36	4	23-10-36	6	3-11-36	6	24-10-36	7	58
17-10-36	4	26-10-36	6	6-11-36	6	25-11-36	7	67
..	..	16-11-36	4	27-11-36	6	16-12-36	6	69
..	..	7-11-36	4	18-11-36	6	3-12-36	6	48
..	..	12-11-36	4	24-11-36	6	12-12-36	..	67
Not noted	..	..	..	..	..	2-6-36	..	43
..	..	12-7-36	..	17-7-36	..	27-7-36	..	40
..	..	11-7-36	..	18-7-36	..	29-7-36	..	42
..	..	26-7-36	..	2-8-36	..	14-8-36	..	42
..	..	25-8-36	..	5-9-36	..	21-9-36	..	67
12-10-36	4	22-10-36	6	3-11-36	6	..	Died in V stage on 15-11-36	69
16-10-36	4	23-10-36	6	2-11-36	6	21-11-36	7	73
21-11-36	4	1-11-36	6	16-11-36	6	6-12-36	7	73
..	..	4-10-36	4	11-10-36	6	26-10-36	6	43
..	..	4-10-36	4	14-10-36	6	28-10-36	6	46
16-10-36	4	25-10-36	6	4-11-36	6	23-11-36	7	61
14-10-36	4	22-10-36	6	31-10-36	6	15-11-36	7	66
..	..	18-10-36	4	26-10-36	6	10-11-36	6	61
..	..	11-11-36	4	25-11-36	6	14-12-36	6	59
..	..	17-11-36	4	27-11-36	6	..	..	..
..	..	8-11-36	4	17-11-36	6	7-12-36	6	62

STATEMENT

Showing the results of rearings of Hoppers fed on different food-plants at Ambagh

(Mr. R. N.

Food plant	Cage No	Date of Hatching	Date of I moult.	No of stripes in early II stage.	Date of II moult.	Stripes in early III stage
Jowar seedlings	D 1	20-4-36	.	..	..	..
	D 2	17-6-36	23-6-36	..	29-6-36	..
	D 3	17-6-36	23-6-36	..	29-6-36	..
	D 4	3-7-36	9-7-36	..	15-7-36	.
	D 5	26-7-36	31-7-36	..	7-8-36	..
	D 6	3-8-36	10-8-36	..	15-8-36	.
	D 7	13-9-36	18-9-36	2	23-9-36	3
	D 8	13-9-36	19-9-36	2	24-9-36	3
	D 9	23-9-36	29-9-36	2	6-10-36	3
	D 10	23-9-36	29-9-36	2	5-10-36	3
	D 11	10-10-36	20-10-36	2	2-11-36	3
	D 12	10-10-36	23-10-36	2	6-11-36	3
	D 13	10-10-36	23-10-36	2	31-10-36	3
Ballboor	F-1	20-4-36	..	..	..	..
	F-2	17-6-36	20-6-36	.	..	..
	F-3	26-7-36	2-8-36	.	8-8-36	..
	F-4	3-8-36	15-8-36	.	31-10-36	..
	F-5	13-9-36	23-9-36	2	6-10-36	3
	F-6	13-9-36	27-9-36	2	6-10-36	3
	F-7	23-9-36	10-10-36	2	21-10-36	3
	F-8	26-9-36	10-10-36	2	19-10-36	3
Mazong rhizoma roots	F-1	20-4-36	Died	..		..
	F-2	17-6-36	7-6-36		Died	..
	F-3	3-7-36	12-7-36		Died	.
	F-4	26-7-36	Died	..	..	.
	F-5	3-8-36	Died	..	..	..
	F-6	23-9-36	8-10-36	2	Died	..
	F-7	23-9-36	6-10-36	2	20-10-36	3
	F-8	10-10-36	2-11-36	2	22-11-36	3
	F-9	18-10-36	30-10-36	2	13-11-36	3

H-II.

with notes on the development of eyestripes in Hoppers.

BATRA.)

Date of extra II moult.	Stripes in early extra III stage.	Date of III moult.	Stripes in early IV stage.	Date of IV moult.	Stripes in early V stage.	Date of V moult.	Stripes in early adult stage.	Total larval period
Not noted.	21-5-36	21-5-36	..	31
..	.	3-7-36	..	9-7-36	..	18-7-36	..	31
..	..	4-7-36	..	9-7-36	..	19-7-36	..	32
..	..	24-7-36	.	31-7-36	..	11-8-36	..	39
..	..	12-8-36	..	19-8-36	..	20-8-36	.	34
..	..	21-8-36	.	4-9-36	..	15-9-36	.	43
..	..	20-9-36	4	6-10-36	5	18-10-36	6	35
..	.	30-9-36	4	7-10-36	5	10-10-36	6	36
..	..	13-10-36	4	21-10-36	5	9-11-36	6	47
..	.	12-10-36	4	19-10-36	5	30-10-36	6	37
..	.	2-11-36	4	23-11-36	5	11-12-36	6	56
..	..	16-11-36	4	27-11-36	5	13-12-36	6	58
.	..	8-11-36	4	18-11-36	5	3-12-36	6	48
..	5-6-36	..	46
..	..	16-7-36	..	25-7-36	..	2-8-36	..	46
..	..	17-8-36	..	26-8-36	..	9-9-36	.	45
..	..	22-9-36	..	4-10-36	..	19-10-36	..	77
9-10-36	4	18-10-36	5	30-10-36	6	20-11-36	7	68
14-10-36	4	24-10-36	5	5-11-36	6	27-11-36	7	76
20-10-36	4	4-11-36	5	10-11-36	6	8-12-36	7	76
..	..	26-10-36	4	14-11-36	5	3-12-36	6	68
..
..
..
..
..
9-11-36	4	Found missing on 15-11-36						
..	..	4-12-36	4	..	..	..	Under observation	
..	..	28-11-36	4	..	..	..	Do.	

STATEMENT H.-III.

The Water-Content of Plants used in Food Experiments at Pasni.

Serial No.	Date of determination.	Percentage of Water Content in each plant								
		Fresh Murrain	Old Marand	Jawari Plant	Jawari Seed lin.	Bull. boor.	Kull. ichl.	Kurzan	Bayra	Name
1	10.12.35	81.60	76.9	77.4	.	72.2	70.5	77.3	..	..
2	25.12.35	83.7	70.2	8.4	..	65.7	73.6	76.8	..	..
3	15.1.36	81.2	70.3	.	..	65.4	81.4	77.8	.	.
4	30.1.36	81.4	.	..	..	69.1	..	..	.	.
5	14.2.36	80.1	80.1	..	..	73.6	80.5	..	..	..
6	29.2.36	87.4	..	.	.	75.80	66.17	..	..	..
7	5.3.36	81.36	.	..	..	69.03	78.63	..	..	..
8	21.3.36	85.15	.	.	..	77.39	77.16	..	..	.
9	10.4.36	84.27	..	..	.	67.0	73.65	.	..	.
10	29.4.36	88.02	..	70.05	..	74.26	76.29	.	..	.
11	9.5.36	85.77	..	85.83	.	72.09	77.14	..	.	.
12	29.5.36	86.35	80.22	81.23	69.42	70.02	70.32	.	..	..
13	9.6.36	84.23	75.47	..	.	67.14	78.55	64.73	..	..
14	27.6.36	75.94	76.05	.	76.20	64.13	75.47	70.29	52.64	76.74
15	13.7.36	82.31	72.22	76.73	..	72.45	71.04	76.92	..	73.11
16	28.7.36	81.12	69.17	69.63	..	69.04	82.13	73.6	..	..
17	4.8.36	82.13	77.34	68.84	..	74.83	81.83	70.45	..	62.16
18	13.9.36	80.44	77.09	79.83	72.41	77.08	74.62	82.66	..	60.39
Average ..		84.36	78.62	77.73	72.7	70.82	77.25	75.38	62.61	60.89

STATEMENT (I) (a).

The number of generations passed through during the year 1936 under semi-natural conditions.

Locality and Generations.	Pre-ovi- position period.	Incubation period.	Larval period.
PASNI.			
<i>Original parent pair.</i>			
<i>From Cage C-43 of 1935—</i>			
Earliest date of :—			
<i>I Generation.</i>			
Copulation	Not noted	32 days.	90 days.
Oviposition	20-xi-35		
Hatching	22-xii-35		
I moult	8-i-36		
II moult	25-i-36		
III moult	21-ii-36		
IV moult	7-iii-36		
V moult	(Adult) 21-iii-36.		
<i>II Generation.</i>			
Earliest date of :—			
Copulation	Not noted.	37 days.	38 days.
Oviposition	28-iv-36.		
Hatching	14-v-36		
I moult	21-v-36		
II moult	27-v-36		
III moult	4-vi-36.		
IV moult	12-vi-36.		
V moult	31-vi-36.		
<i>III Generation.</i>			
Earliest date of :—			
Copulation	27-vii-36	43 days.	42 days.
Oviposition	3-viii-36		
Hatching	18-viii-36.		
I moult	25-viii-36.		
II moult	1-ix-36.		
III moult	8-ix-36		
IV moult	16-ix-36.		
V moult (Adult)	29-ix-36.		
<i>IV Generation.</i>			
Earliest date of :—			
Copulation	12-xi-36	57 days	
Oviposition	24-xi-36.		

Locality and Generation				Pre-natal period	Incubation period	Post-natal period
Annapolis Original Stock						
Earliest date of —						
Oviposition	..	..	Not noted			
Hatching	..	..	29 Jul 25			40 days.
Adults	..	..	9 x 35			
<i>I Generation</i>						
Copulation	..	..	Not noted			
Oviposition	..	..	6 Jul 26	120 days		
Hatching	..	..	16 Jul 26		35 days.	
I moult	..	..	25 Jul 26			
II moult	..	..	31 Jul 26			
III moult	..	..	8 Aug 26			42 days.
IV moult	..	..	15 Aug 26			
V moult (Adult)	..	..	25 Aug 26			
<i>II Generation</i>						
Copulation	..	..	20 Aug 26	20 days.		
Oviposition	..	..	25 Aug 26			
Hatching	..	..	6 Sep 26		35 days	
I moult	..	..	14 Sep 26			
II moult	..	..	20 Sep 26			
III moult	..	..	26 Sep 26			
IV moult	..	..	2 Oct 26			31 days.
V moult (Adult)	..	..	10 Oct 26			
<i>III Generation</i>						
Copulation	..	..	22 Oct 26	52 days.		
Oviposition	..	..	31 Oct 26			
Hatching	..	..	16 Nov 26		10 days.	
I moult	..	..	25 Nov 26			
II moult	..	..	30 Nov 26			
III moult	..	..	8 Dec 26			42 days.
IV moult	..	..	15 Dec 26			
V moult (Adult)	..	..	25 Dec 26			

Locality and Generations.	Pre-ovi. position period.	Incubation period.	Larval period
<p>CHACHRO.</p> <p><i>I Summer Generation.</i></p> <p>Parent Pair:—Migrant adults collected 12-14.vii-36 from Islamkot and put into cage on 27.vii.</p> <p>Earliest date of :—</p> <p>Copulation Not noted.</p> <p>Oviposition Not noted (possibly 10-12.vii.)</p> <p>Hatching 27.viii-36</p> <p>I moult 1-ix-36.</p> <p>II moult 6-ix-36</p> <p>III moult 12-ix-36.</p> <p>IV moult 18-ix-36.</p> <p>V moult (Adult) 27-ix-36.</p> <p><i>II Generation (Summer).</i></p> <p>Earliest date of :—</p> <p>Appearance of yellow tinge in wings 1-x-36</p> <p>Copulation 21-x-36.</p> <p>Oviposition 26-x-36</p> <p>Hatching 21-xi-36.</p>			
		15-17 days.	31 days
	29 days.		
		20 days.	

STATEMENT (1) (b).

The number of generations passed through at Pasm during 1933-36.

Generations.	Pre-ovi- position period.	Incuba- tion period.	Larval period.
1933.			
I Generation.			
Adult stage 19 ix-32	63 days		
Earliest date of :— Copulation . . . 5-vi-32			
Oviposition . . . 21-xi-32		33 days.	
Hatching .. . 21-xii-32			54 days.
Adult .. . 16-ii-33			
II Generation.			
Earliest date of :—			
Copulation .. . 15-iii-33	40 days.		
Oviposition .. . 28-iii-33			
Hatching .. . 19-iv-33		22 days.	
Adult .. . 24-v-33			35 days.
III Generation.			
Earliest date of :—			
Copulation .. . 8-vi-33	17 days.		
Oviposition .. . 10-vi-33		14 days.	
Hatching .. . 24-vi-33			
Adult .. . 28-vii-33			34 days.
IV Generation.			
Earliest date of :—			
Copulation .. . 3-ix-33	40 days.		
Oviposition .. . 6-ix-33		16 days.	
Hatching .. . 22-ix-33			
Adult .. . 11-x-33			50 days.

Generations.	Pre-ovi- position period.	Incuba- tion period.	Larval period.	
1934.				
I Generation.				
Adult stage 26-ix-33	48 days.	32 days.	85 days.	
Earliest date of :—				
Copulation 2-xi-35				
Oviposition 12-xi-33				
Hatching 13-xii-33				
Adult 8-iii-34				
II Generation.				
Earliest date of :—		17 days.	36 days.	
Copulation 19-iv-34	46 days.			
Oviposition 23-iv-34				
Hatching 10-v-34				
Adult 15-vi-34				
III Generation.				
Earliest date of :—		15 days.	34 days.	
Copulation 8-vii-34	26 days.			
Oviposition 11-vii-34				
Hatching 25-vii-34				
Adult 28-viii-34				
IV Generation.				
Earliest date of :—		24 days.		
Copulation 25-ix-34	30 days.			
Oviposition 6-x-34				
Hatching 30-x-34				
Adult ?				

Generations.	Pre-oviposition period.	Incubation period.	Larval period.
1935.			
I Generation.			
II Generation.			
Adults from field kept in cages from Dec. 1934 and January 1935.			
Earliest date of :—			
Oviposition prior to 9-ii-35		Over 35 days.	
Hatching 14-iii-35			
Appearance of Adult 20-iv-35			43 days.
III Generation.			
Earliest date of :—			
Copulation 27-v-35	35 days.		
Oviposition 31-v-35			
Hatching 15-vi-35		15 days.	
Appearance of Adult 25-vii-35			40 days.
IV Generation.			
Earliest date of :—			
Copulation 20-viii-35	35 days.		
Oviposition 28-viii-35			
Hatching 14-ix-35		17 days.	
Adult 9-x-35			56 days.

147

Generations.	Pre-ovi- position period.	Incuba- tion period.	Larval period.
1936.			
I Generation.			
Adult from C-43.			
Earliest date of :—			
Oviposition 20-xi-35			
Hatching 22-xii-35		32 days.	
Adults 21-iii-36			90 days.
II Generation.			
Earliest date of :—			
Oviposition 28-iv-36	37 days.		
Hatching 14-v-36		10 days.	
Adult 24-vi-36			38 days.
III Generation.			
Earliest date of :—			
Oviposition 3-viii-36	43 days.		
Hatching 18-viii-36		15 days.	
Adult 29-ix-36			42 days.
IV Generation.			
Earliest date of :—			
Copulation 12-xi-36	57 days.		
Oviposition 24-xi-36			

STATEMENT J.
Results of Food-preference experiments.
Set 1—HOPPERS.

Type of arrangement of Food-plants in Cage.	Serial No. of experiments.	Number of Hoppers found on each Food-plant.						
		Z.	C.	M.	J.	K.	B.	S.
A	1	5	2	..	3	..	..	1
	2	6	5	2	5	2	..	1
	3	15	4	5	1	..	..	..
	4	11	..	8	2	..	..	..
B	5	7	13	5	6	..	..	..
	6	12	4	1	2	..	..	..
	7	9	3	4	5	..	..	..
C ..	8	3	3	6	2	..	1	..
	9	5	4	1	..	1	..	..
	10	2	1	..	1	..	..	..
	11	8	3	1	..	..	..	3
	12	8	3	4	2	2	1	..
	13	..	..	..	..	..	3	..
	14	13	1	7	3	3	2	..
Total number of Hoppers preferring each plant.		104	46	44	32	8	7	5

STATEMENT J.—*contd.*
Set 2.—HOPPERS.

Type of arrangement of Food-plants in Cage.	Serial No. of experiments.	Number of Hoppers found on each Food-plant.		
		Z.	P.	J.
A	1	7	20	10
	2	14	23	..
	3	13	30	12
B	4	20	13	11
	5	10	3	10
	6	12	16	10
C	7	20	10	1
	8	13	21	1
	9	18	2	..
	10	17	10	3
	11	28	10	3
	12	21	14	3
	13	12	9	..
Total number of Hoppers preferring each plant.		205	205	73

STATEMENT J--*contd.*

Set 3.—HOPPERS.

Type of arrangement of Food-plants,	Serial No of experiments.	Food-plant and No. of hoppers.		
		C.	M.	S.
A	1	7	15	..
	2	23	4	..
	3	2	17	..
B	4	1	9	..
	5	9	3	..
	6	12	9	..
C . . .	7	6	5	..
	8	10	4	..
	9	8	3	..
	10	8	9	..
	11	17	11	3
	12	16	3	..
	13	4	6	..
Total No. of Hoppers found on each plant		123	98	3

Set 4.—HOPPERS.

Type of Disposition of Food-plants in Cage.	Serial No. of experiments	Food-plants and No. of Hoppers.	
		M.	C.
A	1	17	12
B	2	9	2
	3	10	6
	4	10	19
	5	29	19
	6	16	19
Total No. of Hoppers found on each plant ..		90	77

STATEMENT J—*conold.**Set 5.—HOPPERS.*

Type of Disposition of Food-plants in Cage.	Serial No. of experiments.	Food-plant and No. of Hoppers.	
		M.	J.
A	1	17	2
B	2	6	3
	3	12	5
Total No. of Hoppers found on each Plant ..		35	10

Set 6.—ADULTS.

Type of Disposition of Food-plants.	Serial No. of experiments.	Food-plant and No. of Adults.	
		J.	M.
A	I	5	1
	II	4	3
B	III	5	3
Total No. of Adults found on each plant ..		14	7

Abbreviation used.

B.=Baliboor	(Aerua)
P.=Bajra.	(Pennisetum).
J.=Jowari.	(Andropogon).
C.=Kullichk.	(Cyperous).
K.=Kharzan.	(Sericoetoma).
M.=Marrand.	(Heliotropium).
S.=Mazung.	(Sphaerocoma).
Z.=Maize.	(Zea).

STATEMENT K.

Incubation period in relation to sub-soil temperature—with notes on sex-ratio and colour of hatchings.

Ref. No	Date of Oviposition	Date of Emergence	Incubation period (days)	Average temperature at 1" depth	No. and colour of hoppers	Sex ratio.	
						Male.	Female.
H ₁	20 11 35	22-12-35	32	21.6±0.4	23 (Mixed)	..	..
H ₂	21-11 35	27-12 35	36	21.5±0.4	31 (21 green, 13 black)	17.	17
H ₃	28 4 36	14-5 36	16	28.7±5.3	68 (All black, except 2)	46:	23
G ₂	27-4-36	16 5 36	18	28.4±5.2	..	..	..
G ₃	10 8 36	20 8 36	10	30.4±4.4	....	..	..
H ₅	26 6 36	9 7 36	13	32.1±4.2	39 (All green)	23:	15
H ₆	24 6 36	9 7 36	15	32.2±4.1	23 (All green, 1 died)	16:	6
H ₇	24 6 36	9-7-36	15	32.2±4.1	25 (All green)	17:	8
H ₈	28 6 36	12 7-36	14	31.0±4.7	21 (11 green, 7 intermediate, 3 black)	.	..
H ₉	30 6 36	14 7 36	14	33.1±4.6	52 (40 green, 12 black)	25.	27
H ₁₀	1-7-36	15 7-36	14	32.2±4.0	36 (All green except 6)	..	..
H ₁₁	4-7-36	18 7 36	14	33.1±4.8	31 (1 green, 5 black, 2 eaten up)	16:	15
H ₁₂	5 7-36	20 7 36	15	31.4±5.0	24 (19 green, 5 black, 2 eaten up)	11 :	11
H ₁₃	21-7-36	6 8 36	16	32.0±1.0	38 (37 green, 1 escaped)	23:	13
H ₁₄	3 8 36	18 8-36	15	30.7±3.8	29 (25 black, 4 escaped)	17:	8
H ₁₅	4 8 36	20 8 36	16	30.5±4.2	30 (All black)	13:	17
H ₁₆	7 8 36	21 8 36	17	31±4.0	26 (Mixed)	13:	13
H ₁₇	8 8 36	24 8 36	16	30.6±4.4	34 (Mixed)	16:	18
H ₁₈	9 8 36	26 8 36	17	30.4±4.3	21 (Mixed)	12:	9
H ₁₉	..	27-8 36	..	..	57 (All black)	19:	38
H ₂₀	..	5 9 36	..	..	41 (All black)	18:	23
H ₂₁	18 8-36	3 9 36	16	31.0±3.8	17 (Mixed)	8:	9
H ₂₂	21-8 36	7-9 36	17	30.9±3.4	23 (Mixed)	10:	13
H ₂₄	..	13 9 36	..	..	24 (All black)	12:	12
H ₂₅	..	16-9 36	..	..	24 (All black)	11:	18
O ¹ A	25 6 36	9-7-36	14	32.2±4.1	38 (All green)	..	..
O ⁶ B	24 6 36	9-7-36	15	32.1±4.1	23 (20 green, 2 intermediate)	..	..
L ¹ C	24 6 36	9-7-36	15	32.1±4.1	25 (10 green, 6 intermediate)	..	..

Ref. No	Date of Oviposition.	Date of Emergence.	Incubation period (days)	Average temperature at 4" depth.	No. and colour of hoppers	Sex ratio.	
						Male	Female.
C ¹ A	28-6-36	12-7-36	14	33.0 ± 4.6	21 (11 green, 7 intermediate, 3 black)	..	..
C ¹⁵ A	1-7-36	17-7-36	16	33.0 ± 4.8	10 (All green) .. ..	..	..
C ¹⁴ T	8-7-36	22-7-36	14	33.2 ± 4.0	18 (20 green, 28 Black) .. ..	..	..
C ¹⁸ B	7-7-36	22-7-36	15	33.2 ± 4.0	28 (All green) .. ..	..	..
C ⁶ C	10-7-36	22-7-36	12	33.1 ± 4.8	18 (All green) .. ..	..	..
C ⁹ B	11-7-36	25-7-36	14	33.3 ± 5.1	11 (All intermediate) .. ..	..	..
C ⁷ ,A	14-7-36	29-7-36	15	33.2 ± 5.1	28 (All green) .. ..	..	..
C ⁸ D	16-7-36	30-7-36	14	33.3 ± 5.2	28 (Mixed) .. ..	..	..
C ¹¹ A	19-7-36	2-8-36	15	32.0 ± 1.5	35 (Mixed) .. ..	..	..

STATEMENT L-I.
Effect of Exposure to Sunlight on the Colouration of Hind-wings of Schistocerca.

Particulars of Experiment.	Dates of starting.	Dates of Examination I.	Dates of Examination II.	Remarks
<i>Pass I.</i>				
<i>Experiment I</i>	8th June 1936	24th June 1936	5th July 1936	Days very bright and sunny during June, July was misty and cloudy
(1) <i>Right elytron removed:</i> Number of locusts in cage Kept in sunshine. Six (2 males and 4 females).	The hindwings including the wing-bases hyaline.	1. Hind-wings have assumed a light yellow tinge. (1 male missing) wing-base pink or mauve in all on the right side; left wing also pink or mauve in two specimens	1. Wings light yellow, wing- bases pink or mauve on both sides, but colour deeper on the right side.	The general body colour of the locust was pinkish on the 8th June, gradually the coloura- tion assumed a darkish blue hue.
(2) <i>Both elytra removed:</i> Number of locusts kept in cage in the sun: <i>Eight</i> (1 males and 4 females).	Ditto	2. Wings light yellow in all; wing- bases pink or mauve on both sides except in one specimen.	2. Both sides pink or mauve, except in one.	In July, the hind-wings assumed a deep yellow colour the pink and mauve being lost.
<i>Experiment II</i>	4th November 1936	20th November 1936	6th December 1936	Days mostly sunny and bright except in the mornings.
(1) <i>Right elytron removed:</i> 10 locusts (4 males and 6 females).	Hind-wings hyaline mostly but light yellow in some	1. Wings light yellow; light pink or mauve in 3 specimens, on right side in one, and on both sides in two	1. Wings light yellow to yellow. Wing-bases light or deep mauve in most; in one pink turning into mauve; both sides affected	

(2) <i>Both elytra removed</i> : 10 locusts (4 males and 6 females).	Ditto	..	2. Wings light yellow in most; wing bases, pink or mauve on both sides in 3 males.	2. Wings yellow in most; bases: mauve or pink in all and on both sides.	There were a few sunny days in June, but by the last week of the month, the weather changed with the break of the monsoon.
(3) <i>Both elytra intact</i> :— 10 locusts (3 males and 7 females). (Control).	Ditto	..	3. Wings light yellow in most; wing bases light mauve in both wings of 2 females.	3. Wings yellow to light yellow; bases: light tinge of mauve on both wings in 3 locusts.	
ANBAGH.					
<i>Experiment I—</i> <i>Right elytron removed</i> : 4 locusts, fledged on 17th June 1936, were used. Cage kept in the sun.					
	17th June 1936	..	Examined in July, it was found that there was no development of blue or mauve at the wing-bases, the whole wing having turned yellow.	..	Days mostly sunny and bright.
	Wings fully hyaline ..	..		
<i>Experiment II—</i> <i>Right elytron removed</i> : 5 locusts which became adults on 16th September 1936 were used in the experiment.					
	16th September 1936	..	7th September 1936	16th-21st October 1936.		Days mostly sunny and bright mostly.
	Wings fully hyaline ..	..	Mauve or blue tinge distinct at the base of the right hind-wing	Mauve tinge found also on left wing at the base.
<i>Experiment III—</i> <i>Right elytron removed</i> : Six specimens which became adults between the 24th and the 28th October were used.					
	24-28th October 1936	..	22-27th November 1936	..	Days mostly sunny and bright mostly.
	Wings fully hyaline ..	..	Dark mauve or blue tinge was found to have appeared at the base of the right wing	..

STATEMENT L-I—*contd.*

Particulars of Experiment.	Dates of starting.	Dates of Examination I.	Dates of Examination II.	Remarks.
KARACHI.				
Experiment I—				
A dozen specimens with hyaline wings were selected from locusts that had recently become adults in cages, and had the elytra removed, and kept in the sun enclosed in a wire-gauze cage.	15th June 1936 .. Wings fully transparent ..	10th July 1936 .. Wings had assumed a light yellow to deep yellow colour. There was no tinge of blue or mauve at the base of the wings.	..	Days were sunny during the middle of June, but by the last week, it became cloudy, and several showers were also recorded early in July.
Experiment II—				
60 recently fledged specimens had their right elytra removed, before being enclosed in a cage.	10th September 1936 .. Wings fully hyaline ..	32nd October 1936 .. About 20 locusts had definitely developed a pink or mauve tinge at the base of the right wings while the left wings were mostly hyaline.	..	Days in September-October were mostly bright, but as the cages were kept in a place surrounded by tall buildings they did not get more than six hours of sun-shine on the whole.
Experiment III—				
The experiment was repeated in October with 40 newly fledged specimens.	22nd October 1936 .. Wings hyaline ..	14th December 1936 .. A pink or mauve tinge was noticed only in 12 specimens.	..	Days during November-December mostly bright, but the general temperature lower than in October.

STATEMENT L-II.

Showing the effect of Sunlight on "Gregarious" Adult Eyes.

Date.	Cage No., number of locusts, and condition of eyes.		
	SR ₁ (Sunshine) 2 females 4 males.	SR ₂ (Sunshine) 5 females 3 males.	S ₁ (control) (Shade) 2 females 3 males.
26th May 1936..	Eyes claret coloured. No stripes visible, except one at anterior end of eye	Eyes as in SR ₁	Eyes uniformly claret coloured. No stripes visible.
1st June 1936 ..	In three locusts the stripes have cleared; in the other three, not visible.	In four locusts the stripes have cleared; in the other four, not visible.	Eyes as before. One male died.
25th June 1936	Four locusts with clear stripes; the other two without stripes. (One male and one female died).	All locusts with clear stripes (Two males and two females died)	Eyes as before, except in one female where the two anterior stripes are faintly seen.
28th July 1936..	Stripes clear in all (One male died) [Locusts transferred to smaller cage (1'x1'x1½') but still kept in the sun].	Stripes clear in all Locusts transferred to smaller cage (1'x1'x1½'), kept in shade.	Ditto.
7th August 1936	Only one female left, the rest having died. Eye stripes dull.	Only one male left, the rest having died. Eye stripes dull.	Ditto.

STATEMENT M.
Results of Experiments with the Reliberation of Collected Locusts after marking.

Months.	Number liberated.	Number recovered and date of recovery.	Particulars of recovery.	Interval between liberation and recovery.
		PESW, 1915.		
December 1934 ..	About 5 liberated on 29th December	1 on 23rd January 1935 ..	Near place of liberation	25 days.
February 1935 ..	15 locusts liberated between 25th February and 3rd March marked with white paint on thorax.	One male with white paint found on 6th March.	Near place of liberation	About 10 days.
April 1935 ..	150 specimens marked with green paint and liberated.	1 specimen with green paint on 23rd April, 1 on 27th April, 1 on 8th May, 1 on 8th May, and 1 on 10th May.	Within a mile of place of liberation.	Within 2 to 4 weeks.
May 1935 ..	About 30 specimens of locusts during first fortnight, marked with red paint on wings and thorax.	1 on 17th May 1935 at Ramra about 20 miles to the N.E. of Pesw by the Ormara Fieldman.	About 20 miles	Probably about a week.
		1 locust on 20th May on Adasti rek ..	About a mile	1 to 2 weeks (?).
		1 female on 21st May at Ekmasch ..	Do.	Do.
June 1935 ..	1-15 VI. about 25 locusts liberated with blue paint in wings.	1 male recovered in the neighbourhood of laboratory early in July.	Near place of liberation	About 3 to 4 weeks.
July 1935 ..	15-31 VII.—liberated with blue silk and blue paint on wings.	None recovered	None recovered.	....
August 1935 ..	1-31-VIII do.	None recovered	None recovered	....
September 1935 ..	1-30 IX do.	None recovered	None recovered	....

PASA, 1936						
	5 locusts with silk thread and blue paint.		One male found on 16th March with paint mark of II Fortnight of February.	Within 1 mile	..	About 20 days
February 1936	..					
March 1936	..	41 locusts	do.	..		
April 1936	..	5 specimens	do.	..		
May 1936	..	19 specimens	do.	..		
June 1936	..	44 specimens	do.	..		
July 1936	..	27 specimens	do.	..		
August 1936	..	25 specimens	do.	..		
September 1936	..	4 specimens	do.	..		
GWIDAB-JIWANI AREA, 1936.						
May 1936	..	9 locusts liberated with white paint and thread.	Nil.	..	..	....
June 1936	..	19 locusts	do.	..	..	....
July 1936	..	12 locusts	do.	..	..	....
August 1936	..	12 locusts	do.	..	..	....
September 1936	..	12 locusts	do.	..	..	....
			One marked female collected on 2nd October 1936 with paint mark of I fortnight of September.	About 4 or 5 miles from the place of liberation.	..	About 3-4 weeks.
ONGARA AREA, 1936.						
May 1936	..	10 locusts liberated with violet paint and thread.	None recovered	..	..	....
July 1936	..	3 locusts liberated	..	..	..	....
November 1936	..	5 locusts liberated	..	..	..	....

STATEMENT M.—*contd.*

Months.	Number of locusts liberated.	Number recovered and date of recovery.	Particulars of recovery.	Interval between liberation and recovery.
February 1936	I Fortnight: 17 locusts liberated with red paint and thread marks.	None recovered .. ..	....	....
Do.	II Fortnight: Over 50 locusts liberated with red paint and thread marks.	None recovered .. ..	....	....
March 1936 ..	I and II Fortnights: About 50 locusts	One locust on 16-III with marks of March 1-half.	Near place of liberation	A week.
April 1936 ..	I Fortnight: 2 locusts II Fortnight: Nil.	None recovered .. ..	....	....
May 1936 ..	I Fortnight: 13 locusts II Fortnight: 37 locusts	On 17th May, one locust with mark of May 1-half.	Ditto	1-2 weeks.
July 1936 ..	I Fortnight: 9 locusts II Fortnight: 7 locusts	None recovered None recovered None recovered None recovered .. ..	................	................
August 1936	Only four locusts liberated, the population being scanty.	One specimen was collected on 10th November with marks of September 1-half.	Near place of release	9-10 weeks.
September 1936	I Fortnight: 12 locusts II Fortnight: About 20 specimens ..	One locust was found on 13th October and another on 3rd November with marks of September II fortnight.	Ditto	2-3 weeks and 4-5 weeks respectively.

October 1933	..	About 70 specimens during the month.	One locust collected on 23th November with mark of October I-half.	Ditto	..	5 6 weeks.
November 1933	..	Several liberated during the month ..	Two specimens collected on 29th October and one on the 3rd November bore marks of the II-fortnight of October.	Ditto	..	One week and two weeks respectively.
	..		One locust liberated during the first half of November was found dead in the field on 10th November.	Ditto	..	One week.
September 1935	..	10 locusts with green thread mark only	CHICAGO OUTPOST.	....	....	....
October 1935	..	18 locusts with thread mark only ..		....	....	....
November 1935	..	19 locusts with green-coloured paint and thread marks.		All found near place of liberation 2 weeks and 5 weeks and 2 1/2 months respectively.		
March 1936	..	II Fortnight: 3 locusts liberated after marking	None recovered .. ..	....	....	....
August 1937	..	I Fortnight: 3 locusts liberated ..	None recovered .. ..	....	....	....
	..	II Fortnight: 31 locusts liberated ..	None recovered .. ..	....	....	....
September 1938	..	I Fortnight: 22 locusts liberated ..	None recovered .. ..	....	....	....
	..	II Fortnight: 16 locusts liberated ..	None recovered .. ..	....	....	....
September 1935	..	42 locusts liberated with white paint and thread marks	BARNES OUTPOST.	....	....	....
October 1935	..	40 specimens liberated after marking ..		....	....	....
November 1935	..	15 locusts liberated after marking ..		....	....	....

STATEMENT M.—*concl.*

Month.	Number of locusts liberated	Number recovered and date of recovery.	Particulars of recovery.	Interval between liberation and recovery.
October 1935	30 locusts liberated after marking with chocolate coloured paint and thread.	None recovered .. ..	....	....
October 1936	I Fortnight: 7 locusts liberated after marking. II Fortnight: 63 locusts liberated after marking	None recovered One locust collected on 18th November 1936 bearing mark of October II half.	.... Collected $\frac{1}{2}$ mile to N. E. of place of liberation.	.... 4 weeks.
November 1936	I Fortnight: 11 locusts liberated .. II Fortnight: 146 locusts liberated..	None recovered No recoveries yet .. ..	........	........
September 1936	SANDSHIRE OUTPOST. 6 locusts liberated with yellow paint and thread marks.	None recovered .. ..	....	....
October 1936	6 locusts liberated	No recoveries .. ..	....	....
November 1936	3 locusts liberated	No recoveries .. ..	....	....

STATEMENT N.

Biometrical Analysis and number of eye-stripes, month by month, of Locusts collected at Pasni during the period from December 1935 to November 1936.

E/F ratios:—

I. 2.05 and below :
 II. 2.06 to 2.15 :
 III. 2.16 and above :

Solitaria (Sol.).
 Transiens or Intermediate (Int.).
 Gregaria (Gr.).

Month.	Total No. of specimens examined.	No. of specimens in each phase.		D/T ratios (classified).	No. of specimens with:—		Remarks.
		Phase.	No.		6-striped eyes.	7-striped eyes.	
Dec. 1935 ..	18	Sol.	12	I—1.03, 2.01, 2.01, 2.00, 2.02, 2.03, 1.02, 2.03, 2.05, 1.08, 2.00, 2.00.	11	7	Both new generation (probably immigrants) and old generation forms met with. Hindwings, yellow or light yellow, with pink, blue or mauve bases in some. Mostly solitaria.
		Int.	4	II—2.09, 2.11, 2.11, 2.09.	..	..
		Gr.	2	III—2.23, 2.17.			
Jan. 1936 ..	16	Sol.	8	I—1.06, 2.05, 2.03, 2.01, 2.03, 2.03, 1.06, 2.02			Do.
		Int.	4	II—2.07, 2.12, 2.07, 2.06.	..	..
		Gr.	3	III—2.17, 2.18, 2.19.			
Feb. ..	2	Sol.	2	I—2.00, 2.03 ..	..	..	Hindwings yellow, without purple bases. Red mites present on wings and body.
		Int.	..	II—	..	..
		Gr.	..	III—	..	..
March ..	44	Sol.	21	I—2.03, 2.01, 2.00, 1.06, 2.00, 2.03, 2.03, 2.01, 2.01, 1.03, 2.03, 2.00, 2.00, 2.00, 2.03, 2.03, 2.03, 2.00, 2.03, 1.02.	12	20	Hindwings yellow or bright yellow, with blue bases in some. Red mites present on wings and body in a few.
		Int.	21	II—2.14, 2.06, 2.09, 2.07, 2.11, 2.06, 2.11, 2.08, 2.09, 2.11, 2.12, 2.11, 2.13, 2.12, 2.06, 2.00, 2.11, 2.11, 2.06, 2.06, 2.07.	..	..	Mostly solitaria and transiens forms.
		Gr.	2	III—2.19, 2.17 ..	..	..

STATEMENT N.—*contd.*

Month	Total No of specimens examined.	No. of specimens in each phase.		E/T ratios (classified).	No. of specimens with —		Remarks.
		Phase	No.		6 striped eyes.	7-striped eyes.	
April ..	6	Sol.	3	I—2 00, 2-03, 1-02	..	..	Population very low.
		Int.	1	II—2 06	1	6	New generation adults, with clear wings, beginning to appear in second fortnight
		Gr.	2	III—2-11, 2-11	..	..
May ..	60	Sol.	20	I—1-00, 2-02, 2 00, 1-04, 2-03, 2-03, 2-05, 2 01, 2 03, 2-03, 2 01, 2 01, 2 00, 2 03, 2 01, 2-05, 1-05, 2 00, 1-00, 1-05, 2 01, 1-04, 2 01, 1 00, 2 01, 2 01, 1-04, 2-01.	40	15	Handwings clear or yellow. Population increased towards end of month due to the entrance of immigrants with mauve or blue wing bases, probably from the west. Red mites present on some locusts.
		Int.	29	II—2-14, 2-00, 2-13, 2-07, 2-04, 2-07, 2-14, 2-07, 2-00, 2-13, 2-11, 2 04, 2-12, 2 07, 2-10, 2-12, 2-07, 2-10, 2-12, 2-13, 2-13, 2-05, 2-07, 2 00, 2-00, 2-07.			Mostly solitary and transiens forms.
June ..	63	Gr.	3	III—2-17, 2-10, 2-18			
		Sol.	31	I—2 03 1-04, 2-05, 1-04, 2-00, 2 04, 1-04, 2-05, 1-07, 2 00, 2 04, 2-00, 2-04, 1-03, 2-03, 2 03, 2-05, 2 00, 2-02, 2-02, 2-00, 2-02, 2-04, 1-02, 2-03, 2-04, 2-01, 2-01, 2-01, 1-09, 2-03.	38	17	Handwings yellow or bright yellow, with purple bases in some. Mostly solitary and transiens forms

STATEMENT N.—*contd.*

Month	Total No. of specimens examined.	No. of specimens in each phase.		L/T ratios (classified).	No. of specimens with —		Remarks.
		Phae.	No		6 striped eyes.	7 striped eyes	
<i>June—contd.</i>		Int.	19	II—2.10, 2.08, 2.07, 2.07, 2.06, 2.11, 2.14, 2.07, 2.06, 2.07, 2.00, 2.13, 2.13, 2.14, 2.09, 2.13, 2.13, 2.11, 2.15.			
		Gr.	3	III—2.21, 2.16, 2.17.			
July ..	33	Sol.	17	I—2.05, 1.91, 1.90, 2.00, 2.00, 1.94, 2.00, 1.97, 2.01, 1.99, 2.00, 1.96, 2.03, 2.01, 2.00, 1.92, 1.93	22	10	Hindwings yellow or light yellow, with mauve or blue bases. Red mites present on wings of some.
		Int.	16	II—2.11, 2.12, 2.08, 2.07, 2.06, 2.12, 2.09, 2.12, 2.12, 2.09, 2.13, 2.13, 2.09, 2.10, 2.12, 2.11			
		Gr.	..	III— ..			
Aug. ..	29	Sol.	13	I—2.00, 1.95, 2.02, 2.00, 1.97, 2.01, 1.96, 2.00, 2.01, 2.00, 1.91, 1.90, 1.90.	22	7	Hindwings bright yellow with purple bases in some.
		Int.	15	II—2.09, 2.09, 2.04, 2.11, 2.10, 2.09, 2.12, 2.10, 2.11, 2.09, 2.07, 2.11, 2.06, 2.12.			
		Gr.	1	III—2.2 ..			
Sep ..	7	Sol.	3	I—1.94, 2.05, 2.00.	3	1	Hindwings light yellow with mauve base. Population very low.
		Int.	4	II—2.07, 2.09, 2.10, 2.08.			
		Gr.	..	III— ..			

STATEMENT N.—*contd.*

Month	Total No of specimens examined.	No of specimens in each phase		LT ratios (classified)	No of specimens with —		Remarks.
		Phase.	No		6-striped eyes	7-striped eyes	
Oct ..	32	Sol	10	I—2 07, 2 07, 2 00, 2 01, 2 00, 2 02, 2 01, 2 02, 2 01, 1 07, 2 00, 2 00, 1 00, 2 01, 2 05, 1 08, 2 01, 2 01, 2 02.	27	0	<i>Beginning of month.</i> — A small increase in population due probably to an immigration possibly from Kolsa. Hindwings clear (indicating new generation forms) or light yellow with purple bases. More transverse forms than solitary.
		Int	13	II—2 07, 2 12, 2 12, 2 06, 2 17, 2 00, 2 11, 2 16, 2 08, 2 12, 2 10, 2 09, 2 07.			
		Gr.	.	III— ..			
Nov. ..	41	Sol	27	I—1 08, 2 00, 2 00, 1 00, 1 01, 2 05, 2 00, 2 01, 2 03, 1 05, 2 05, 1 07, 2 09, 2 01, 2 02, 2 00, 1 00, 2 02, 1 06, 2 03, 1 02, 1 03, 1 07, 1 02, 2 00, 1 01, 1 06.			The immigration which started towards the end of October, continued throughout November.
		Int	14	II—2 17, 2 08, 2 07, 2 07, 2 12, 2 08, 2 05, 2 06, 2 03, 2 06, 2 07, 2 06, 2 07, 2 14			
		Gr.	..	III—NR,			

STATEMENT O.

Painted-Box Experiments. (Dr. M. L. Roomwal).

In order to study the effect of the colour of environment on that of locusts, hoppers were reared in small, wooden boxes (9.5 cm. \times 8.5 cm. \times 12 cm.), with their inner walls painted in different colours. The boxes were closed on all sides except at the top which was of wire-gauze. The boxes were kept in the shade of the verandah and not exposed to direct sunlight. To start with, green hoppers were taken in nearly all cases, except one, when a black hopper was used. Table 10 gives the eight colours used and the results obtained therefrom :—

Table 10.

Inside colour of rearing box.	Colour of the resulting insect.	
	Old hopper stages.	Adult.
Lemon yellow ..	Bright yellowish green ..	Light green.
Prussian blue ..	Fawn or green base with black markings.	Brownish or pinkish grey.
Mahogany	Do. ..	....
Black	Dark green or dirty fawn base with black markings.	Smoky brown or ash coloured.
Dark green	Bright green	Light green.
Signal red	Dirty green or orange ..	Grey with violet tinge, especially on hind legs.
White	Generally greenish white ..	Whitish fawn.
Light ochre (unpainted wood).	Pale green with or without yellowish tinge.	Dull brown.

Out of nearly 64 experiments which were performed, only 19 reached sufficiently advanced stage to permit of any deductions being made. The rest

STATEMENT O—*contd.*

terminated with the death of the first or second hopper stages. The following is a brief account of each set of experiments :—

1. *Lemon yellow*.—Nine experiments were started for this colour, but five died in the first stage and two in the second. Of the remaining two, one was reared up to the fourth and the other to the adult stage.

2. *Prussian blue*.—Nine experiments were started for this colour, but six died in the first stage and one the second. The remaining two were reared up to the adult stage.

3. *Mahogany*.—Nine experiments were started for this colour, but five died in the first stage and two in the second. Of the remaining two, one was reared up to the third and the other to the adult stage.

4. *Black*.—Seven experiments were started for this colour, but four died in the first stage. Of the remaining three, two were reared up to the adult stage and one up to the fourth.

5. *Dark Green*.—Eight experiments were started for this colour, but five died in the first stage and one in the second. Of the remaining two one was reared up to the third and the other to the adult stage.

6. *Signal red*.—Nine experiments were started for this colour, but seven died in the first stage. The remaining two were reared up to the adult stage.

7. *White*.—Ten experiments were started for this colour, but six died in the first stage. Of the remaining four, two were reared up to the fourth, one to the fifth and one to the adult stage.

8. *Light ochre (unpainted)*.—Three experiments were started for this colour. Of these one died in the first stage, the second was reared up to the fourth and the third to the adult stage.

Results.—It will be seen from Table 10 that some colours were apparently simulated, whereas in others the results were indefinite. Colours which were simulated to a greater or less extent were: light yellow black, dark green and white. Hoppers reared in the mahogany coloured boxes became fawn coloured in the fourth stage. This is not regarded as due to the mahogany box, since a hopper reared in the prussian blue box also became fawn. Moreover, the fawn colour sporadically appears in solitary hoppers reared in identically coloured cages, where the factor of the environmental colour cannot be correlated with the colour of the hopper.

It should be pointed out that one may not reasonably expect a locust to simulate any colour to which it is exposed, and that there are probably limitations to which the insect is subject in this respect. Nevertheless, the fact remains that, to a greater or less extent, the locust can simulate certain environmental colours. The results presented here broadly confirm those obtained on *Locustana pardalina* by Faure (1932) in South Africa, although the simulated colours are not precisely the same in both the cases.

STATEMENT P (I).

The development of Eye-stripes in individual Hoppers with 6 & 7 striped eyes
(as determined by Dr. M. L. Roonwal).

Serial No	Cage No.	Sex.	Colour.	Number of eye-stripes in different stages.												Remarks.
				I		II		III		IV		V		Adult.		
				E	L	E	L	E	L	E	L	E	L	E	L	
	6=SLIPPER TYPE.															
1	B(c) 4 (3)	M.	Green	..	.	.	.	3	..	1	4		..	6	6	
12	n ⁵ .	M.	Green	..	1	2	..	3	..	4	..	4-1	5	6	..	
10	B(b) 4 (3)	M.	Green	.	.	2	..	3	..	4	..	5	..	6	6	
20	B(b) 5 (3)	M.	Green	.	.	2	..	3	.	4	..	5	..	6	6	
21	n ⁴ .	M.	Green	..	1	2	.	3	..	4	..	4-1	..	6	6	
35	K17 (a) 6	M.	Inter	..	.	2	..	3	..	4	..	5	..	6	6	
36	K17 (a) 7	M.	Inter	..	..	2	..	3	..	4	5	5	..	6	6	
38	K ⁴¹ .	M.	Green	..	..	2	..	3	..	4	..	5	..	6	6	
30	K ⁶⁶ ..	M.	Green	.	..	2	.	3	..	4	..	5	..	6	6	
	7=SHRIMP TYPE.															
2	B 8 (a) ..	M.	Green	1	1(1)	2	..	3(1)	..	4(1)	5	6	..	7	7	
5	B(c) 5(3)	M.	Green	..	..	2	3	3-1	4	5	..	6	..	7	7	
6	n ¹ ..	M.	Green	..	2	2	.	3-1	..	4-1	..	5-1	6-1	7		
11	B(c) 2 (2)	M.	Green	.	..	2	.	3-1	4	5	.	6	..	6	7	
12	K17(b) 1 ..	M.	Green	..	..	2	..	4	..	5	..	6	..	7	7	
31	B(b) 3 (3)	F.	Green	..	..	2	..	3-1	..	4-1	..	5-1	6	7	7	
37	K18 (a) ..	F.	Green	..	.	2	..	4	..	5	..	6	..	7	7	
42	n ²² ..	F.	Green	..	1	2	..	3-1	..	4-1	..	5-1	..	7	..	
44	K17 (b) 3 ..	F.	Green	..	..	2	..	4	..	5	..	6	..	7	7	
51	K17 (a) 1 ..	F.	Inter	..	..	2	..	3-1	4	5		6	..	7	7	
53	K17 (a) 3	F.	Inter	..	..	2	..	4	..	5	..	6	..	7	7	

STATEMENT P (II).

*Number of Eye-stripes during extra moulting.*A. First instar of the stage during
extra moultB. Second instar of the stage during (As observed by Dr. M. L.
extra moult. Roonwal).

Serial No.	Cage Number.	Sex.	Number of eye stripes in various stages										Remarks.
			II		III		IV		V	Adult.			
			A.	B.	A.	B.	A.	B.					
1	3	Female	2		4	4	5		6	7 — 8	The eighth stripe in the adult was developed four days after ecolo- sion, and is an abnormality. Died in IV stage. Two extra moults.
2	B ⁸	Female	..	1	2	2	4		5	6	..	..
3	12	Female	..	1	2		3	4	5		6	7	
4	a ²⁰	Male	..	..	2		3	4	5		6	7
5	B(b) 1 (3)	Female	..	1	2		3	4	5		6	7	
6	B(b) 3 (3)	Female	..	..	2		4		4	5	6	7
7	K ¹	Female	..	..	2		4	4	5		6	7
8	K ²⁴	Male	..	..	..		3	4	5		6	7
9	K ³⁷	Male	..	..	..		3	4	5		6	7
10	K ⁴⁶	Female	..	..	.		3	4	5		6	7
11	K ⁵¹	Female	..	..	.		3	4	5		6	7
12	K ⁵²	Female	..	..	..		3	4	5	6	6	7

STATEMENT P (II).
Table of rearings at Karachi, showing the development of Eye-stripes among the Hoppers.
 (Dr. S. Mukherji.)

Serial Cage No.	Date of Hatching.	No. of str. in late I inst.	Date of I moult.	No. of str. in late II inst.	Date of II moult.	No. of str. in late III inst.	Date of extra III moult.	No. of str. in late III inst.	Date of III moult.	No. of str. in late IV inst.	Date of IV moult.	No. of str. in late V inst.	Date of V moult.	Adult stages.	Sex.
Sun C-1	Prior to 26. viii.	2	12. ix-36	3	18. ix-36	4	20. ix-36	5	6. x-36	6	14. x-36	7	3. x-36	7 (Prom. on 3. x).	Female.
Sun C-3	Prior to 4. viii.	2	12. viii	3	21. viii-36	4	30. viii-36	6	7. ix-36	6	18. ix-36	7	5. x-36	7 (Prom. on 12. x).	Female.
Sun C-4	Prior to 2. viii.	2	21. viii	3	2. ix-36	4	9. ix-36	5	18. ix-36	6	30. ix-36	7	16. x-36	7 (Prom. on 21. x).	Female.
Sun C-5	Prior to 15. viii.	2	23. viii-36	3	29. viii-36	4	..	..	12. ix-36	5	Became Adult—Eye-stripes Wings crumpled.	5	..	5	Male.
Sun C-6	Prior to 1. viii.	2	6. viii-36	3	27. viii-36	4	5. ix-36	5	14. ix-36	6	25. ix-36	7	11. x-36	7 (Prom. on 21. x).	Male.
Sun C-7	Prior to 1. viii.	2	6. viii-36	3	25. viii-36	4	3. ix-36	5	14. ix-36	6	25. ix-36	7	9. x-36	7 (Prom. on 10. x).	Male.
Sun C-9	Prior to 29. vii.	2	6. viii-36	3	4. ix-36	4	..	..	10. ix-36	5	26. ix-36 (6 distinct stripes; interspaces pigmented)	6	5. x-36	6	Male.
Sun C-10	Prior to 14. viii.	2	24. viii	3	30. viii-36	4	8. ix-36	5	14. ix-36	6	25. ix-36 (7th stripe variable after the penultimate moult) (Died on 15. x-36).	7	12. x-36	7	Female.

STATEMENT P (III)—*contd.*

Serial Cago No.	Date of Hatching	No. of str. in late I inst.	Date of I moult.	No. of str. in late II inst.	Date of II moult.	No. of str. in late III inst.	Date of extra III.	No. of str. in late III inst.	Date of III moult	No. of str. in late IV inst.	Date of IV moult	No. of str. in late V inst.	Date of V moult.	Adult stripes.	Sex.
Sun C-12 ..	Prior to 17-viii	2	24 viii	3	27-viii	4	..	..	6 ix '36	5	15 ix-'36 (6th stripe appeared as a pale brown incomplete line on dorsal one-third, sickly).	6	1 x-'36	6	Female.
Sun C-(viii) ..	Prior to 20-x	2	7-xi	3	10-xi	4	..	..	20-x	5	12-xii	6	under rearing	6	Male.
Shade C-x ..	Prior to 4 xi	2	5-xi	3	11-x	4	20-xi	5	2 xi	6	1.-xii	..	under rearing	..	Female.
Sun C-(i) ..	Prior to 27-x	2	11-xi	3	10 xi	4	28 xi	5	10 xii	6	..	..	under rearing	..	Female.
Sun C-(ii) ..	Prior to 27-x	2	7-xi	3	18 xi	4	25 xi	5	7-xii	6	..	..	under rearing	..	Female.
Shade C-i ..	Prior to 7-xi	2	14-xi	3	23 xi	4	30-xi	5	10-xii	6	..	..	under rearing	..	Female.
Shade C-vi ..	Prior to 20-x	2	5 xi	3	10-xi	4	6-xi	5	0 xii	6	..	..	under rearing	..	Female.

STATEMENT Q.

Statement showing the staff employed under the Locust Research Entomologist to the Imperial Council of Agricultural Research, Karachi, during 1936-37.

Name and Designation.	Date of appointment.	Present pay.	Remarks
A.—HEADQUARTERS.			
1. Rao Bahadur Y. Ramchandran Rao, M.A., F.R.C.S., Locust Research Entomologist, Karachi.	13th Dec. 1930	Rs. 1,000 plus Karachi Local Allowance Rs. 60 per mensem.	On Foreign Service
2. Dr. Mukerji, D.Sc., Assistant Entomologist, Karachi.	10th Jan. 1936.	Rs. 200 plus Karachi Local Allowance Rs. 16 per mensem.	
3. Mr. Ram Lal Gupta, M.Sc., Biometrical Assistant.	10th Oct. 1936.	Rs. 80 plus Karachi Local Allowance Rs. 10 per mensem.	
4. Mr. Abdul Ghani, Head Clerk	11th Jan. 1931.	Rs. 160 plus Karachi Local Allowance Rs. 16 per mensem.	On Foreign Service.
5. Mr. R. L. Mehta, B.A., 2nd Clerk.	19th Feb. 1935	Rs. 50 plus Rs. 10 as special pay and Karachi Local Allowance Rs. 7-8 per mensem.	Left to take up appointment in the Imperial Institute of Sugar Technology from 2nd October 1936.
.. Mr. H. G. Sheikh, 2nd Clerk	2nd Oct. 1933.	Rs. 60 plus Rs. 10 as special pay and Karachi Local Allowance Rs. 7-8 per mensem.	Appointed as 2nd Clerk from 28th September 1936.
6. Mr. Shafkatullah, 3rd Clerk..	1st Dec. 1935.	Rs. 40 plus Karachi Local Allowance Rs. 7-8 per mensem.	Left to take up appointment in the Imperial Institute of Sugar Technology from 2nd October 1936.
.. Mr. Khushi Mohammad, 3rd Clerk.	29th Sep. 1936	Rs. 40 plus Karachi Local Allowance Rs. 7-8 per mensem.	Appointed as 3rd Clerk from 28th September 1936.
7. Mr. Chandar Parkash, Senior Compiling Assistant.	27th April 1933.	Rs. 84 plus Karachi Local Allowance Rs. 12-8 per mensem.	Left to take up appointment in the Imperial Institute of Sugar Technology from 4th October 1936.
.. Mr. V. Ramani, Senior Compiling Assistant	28th Sep. 1936	Rs. 65 plus Karachi Local Allowance Rs. 10 per mensem.	Appointed as Senior Compiling Assistant from 26th September 1936.
8. Mr. H. G. Sheikh, Junior Compiling Assistant.	2nd Oct. 1933	Rs. 64 plus Karachi Local Allowance Rs. 7-8 per mensem.	Appointed as 2nd Clerk from 28th September 1936.
.. Mr. M. A. Latif Sabir, Junior Compiling Assistant.	9th Oct. 1936.	Rs. 50 plus Karachi Local Allowance Rs. 7-8 per mensem.	Appointed as Junior Compiling Assistant from 9th October 1936.
9. Mr. Navindar Singh, Draftsman.	19th Aug. 1935.	Rs. 45 plus Karachi Local Allowance Rs. 7-8 per mensem.	

Name and Designation	Date of appointment.	Present pay.	Remarks.
<i>Fieldmen</i>			
1 Fieldman on Rs 53 including Rs 20 Motor Lorry Allowance		Rs. 53 plus Rs 6 House Rent and Karachi Local Allowance.	
1 Fieldman on Rs 30 .. ..	..	Rs 30 plus Rs 6 House Rent and Karachi Local Allowance	
<i>Peons</i>			
1 Peon on Rs 18 plus Rs 6 House Rent, etc., per mensem	..	Rs 18 plus Rs. 6 House Rent and Karachi Local Allowance.	
2 Peons on Rs 17 plus Rs 6 House Rent, etc., per mensem, each		Rs 17 plus Rs. 6 House Rent and Karachi Local Allowance, each.	
B—SURVEY PARTY.			
<i>Barmer.</i>			
1. Mr. Desraj Bhatia, M.Sc., Locust Research Assistant.	2nd Jan 1931	Rs 180 per mensem.	
1 Fieldman on Rs 31 .. ..	..	Rs 31 per mensem	
1 Peon on Rs 15 .. ..	..	Rs. 15 per mensem	
1 Messenger on Rs 12 .. ..	..	Rs 12 per mensem	Temporarily employed for six months.
<i>Chachro</i>			
1 Fieldman on Rs 32 .. ..	..	Rs 32 per mensem.	
1 Fieldman on Rs 31 .. ..	..	Rs 31 per mensem.	
2 Messengers on Rs 12 per mensem, each.	..	Rs 12 per mensem, each	
<i>Sardar Shahr.</i>			
1 Fieldman on Rs 33 .. ..	..	Rs. 33 per mensem	
1 Fieldman on Rs 32 .. ..	..	Rs 32 per mensem	
2 Messengers on Rs 12 per mensem, each	..	Rs 12 per mensem, each.	
<i>Nal.</i>			
2 Fieldmen on Rs 32 per mensem, each	..	Rs. 32 per mensem, each.	
2 Messengers on Rs 12 per mensem, each	..	Rs 12 per mensem, each.	
C—PABOT, etc			
<i>Pasni.</i>			
1. Dr M L Roonwal, Ph D, Assistant Entomologist	6th Nov. 1935	Rs 250 plus Mekran Allowance Rs 50 per mensem	
2. Mr S M. Inqar Ahsan, MSc, Locust Research Assistant.	29th March 1931.	Rs 145 plus Mekran Allowance Rs 25 per mensem.	
3. Mr. Rahmatullah Dutt, MSc, Locust Research Assistant.	12th Dec 1935	Rs 125 plus Mekran Allowance Rs 25 per mensem.	Left service from 16th August 1938.

Name and Designation.	Date of appointment	Present pay.	Remarks
.. Mr. Rashid Ahmed B.Sc. .. (Hons.), Locust Research Assistant.	23rd Aug 1936.	Rs. 125 plus Mekran Allowance Rs. 25 per mensem.	Promoted from 17th May 1936
4. Mr. Abdul Halim, Clerk, on Rs. 60 per mensem.	10th June 1932	Rs 60 per mensem ..	Left to take up appointment in the Imperial Institute of Sugar Technology, from 2nd October 1936.
.. Mr. Naurata Singh, Clerk, on Rs 50 per mensem.	18th Oct 1935	Rs 50 per mensem .	Promoted as Clerk from 18th October 1935.
<i>Fieldmen.</i>			
6 Fieldmen on Rs. 40, each	Rs. 40 per mensem, each.	
1 Fieldman on Rs. 21 (Local)	..	Rs. 21 per mensem.	
1 Fieldman on Rs. 20 (Local)	..	Rs 20 per mensem.	
<i>Messengers.</i>			
2 Messengers on Rs. 12, each	..	Rs. 12 per mensem, each.	
<i>Peons.</i>			
3 Peons on Rs. 18, each	Rs. 18 per mensem, each.	
1 Water-Carrier on Rs 12	Rs 12 per mensem	
<i>Quadar.</i>			
1 Fieldman on Rs. 40	Rs. 40 per mensem.	
1 Messenger on Rs. 12	Rs. 12 per mensem.	
<i>Turbat.</i>			
1 Fieldman on Rs. 40	Rs. 40 per mensem.	
1 Messenger on Rs. 12	Rs. 12 per mensem.	
<i>Panigur.</i>			
1 Fieldman on Rs. 43	Rs. 43 per mensem.	
1 Messenger on Rs. 12	Rs. 12 per mensem	
<i>Ambagh.</i>			
1. Mr. R. N. Batra, M. Sc., Locust Research Assistant	27th May 1935	Rs. 135 plus Mekran Allowance Rs. 25 per mensem.	
<i>Fieldmen.</i>			
1 Fieldman on Rs. 41	Rs. 41 per mensem.	
1 Fieldman on Rs. 40	Rs. 40 per mensem.	
1 Fieldman on Rs. 32	Rs. 32 per mensem.	
<i>Messengers.</i>			
2 Messengers on Rs. 12, each..	..	Rs. 12 per mensem, each.	
1 Peon on Rs. 18	Rs. 18 per mensem.	

Y. RANCHANDRA RAO,

*Locust Research Entomologist to the Imperial Council of
The 12th December 1936, Agricultural Research, Karachi.*

STATEMENT R.

Statement showing the estimated total expenditure of the office of the Locust Research Entomologist to the Imperial Council of Agricultural Research, Karachi, for the year 1936-37.

Budget Sub Heads	Actuals upto 30 11 36 (for 8 months)	Probable upto 31-3 37 (for 4 months)	Probable total expendi- ture for the year 1936 37.	San- ctioned Grants	Probable	
					Saving	Additional require- ments
	Rs	Rs	Rs	Rs	Rs	Rs
A.—HEADQUARTERS						
I.—PAY.						
1 Pay of officer	8,000	4,000	12,000	12,000	Nil.	Nil.
2 Pay of Establishment	6,408	3,307	9,865	10,100	325	.
II.—ALLOWANCES, HONORARIA, ETC.						
1 House Rent and Other Allowances						
(a) to officer	480	210	720	720	..	..
(b) to Establishment ..	699	435	1,134	1,572	438	.
2 Travelling Allowance—						
(a) Officer.. ..	1,524	1,120	2,650	3,000	350	..
(b) Establishment	420	410	830	1,000	170	..
III.—CONTINGENCIES, SUPPLIES AND SERVICES						
Contingencies, etc.	2,060	910	3,000	3,000	..	..
IV.—GRANTS-IN-AID, ETC						
Leave and Pension contributions of lent staff:—						
(a) Officer.	1,000	950	2,850	2,760	..	90
(b) Establishment	221	101	325	305	..	20
V.—Deputation to International Locust Conference—Egypt						
	515	.	515	..	..	515
GRAND TOTAL	22,297	11,602	33,959	34,647	1,283	625
					1,658	
B.—SURVEY PARTY						
I.—PAY.						
Pay of Establishment	3,025	1,070	5,005	5,692	..	13
II.—ALLOWANCES, HONORARIA, ETC.						
T. A. of Establishment	2,321	2,070	5,000	5,000	..	..
III.—CONTINGENCIES, SUPPLIES AND SERVICES						
Contingencies, etc.	2,235	705	3,000	3,000	..	.
GRAND TOTAL	8,482	5,418	13,005	13,692	..	13
					13	

STATEMENT R—*contd.*

Budget Sub-Head.	Actuals upto 30-11-36 (for 8 months)	Probable upto 31-3-37 (for 4 months).	Probable total expendi- ture for the year 1936-37.	San- ctioned Grants.	Probable.	
					Savings	Additional requirements.
C.—PASNI, ETC.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
I.—PAY.						
Pay of Establishment ..	10,255	5,288	15,543	10,818	1,305	..
II.—ALLOWANCES, HONORARIA, ETC.						
1. House Rent and Other Allow- ances to Establishment ..	355	535	1,400	1,500	100	.
2. Travelling Allowance of Estab- lishment	5,200	2,710	8,000	4,000	..	4,000
III.—CONTINGENCIES, SUPPLIES AND SERVICES.						
1. Contingencies, etc.	3,701	1,000	5,400	3,500	..	1,900
2. Construction of Laboratory and Residential quarters at Pasni ..	2,438	902	3,400	..	..	3,400
GRAND TOTAL ..	22,552	11,101	33,743	25,818	1,405	0,300
					—7,895	

SUMMARY.

A.—HEADQUARTERS ..	..	..	33,880	31,547	+ 058	..
B.—SURVEY PARTY ..	..	..	13,005	13,602	—13	..
C.—PASNI, ETC. .	..	..	33,743	25,818	—7,895	..
			81,537	74,287	—7,250	

N.B.—1. The increase of expenditure on account of Travelling Allowance of establishment under 'C—Pasni, etc.', is mostly due to the grant of leave to some of the superior staff who were paid Travelling Allowance under F. R. 105 (d) read with S. R. 141 and to the transfer of Biometrical Assistant from Pasni to Karachi in January and vice versa in May 1936, as Locust Research Assistant at Pasni. It also includes Travelling Allowance of Establishment for the month of January to March 1936 which could not be paid before the close of the financial year 1935-36.

2. The increase of expenditure under 'C—Pasni, etc.—Contingencies etc.' is due to the purchase of new Scientific apparatus such as self-registering Thermohygrograph, self registering Hygrographs and payment for the Field cages provided last year at Pasni and Ambigh, and was unavoidable. The purchase of Hygrographs was recommended by the Locust Committee in January 1936.

3. A sum of Rs. 6,000 was provided in the Budget for the year 1934-35 for 'Construction of Laboratory and residential quarters at Pasni' out of which Rs. 3,581 was spent in the year 1935-36 and the remainder Rs. 2,438 was paid during the current financial year. The Building Supervisor who inspected the buildings after their completion in January 1936, has suggested certain improvements to make buildings more stable. Provision has been made for carrying out the repairs which would cost about Rs. 902, for which sanction has already been granted by the Vice Chairman, I. C. A. R.

Y. RANCHIANDRA RAO,

*Locust Research Entomologist to the
Imperial Council of Agricultural Research,
The 22nd December 1936.
Karachi.*

STATEMENT S.

Budget estimates of the Office of the Locust Research Entomologist to the Imperial Council of Agricultural Research, Karachi, for the year 1937-38.

A.—HEADQUARTERS.

I.—Pay.

	Rs	Rs.
1. Pay of Officer. (Locust Research Entomologist) on Rs. 1,000 per monsem. . . . .	.	12,000
2. Pay of Establishment—		
1 Assistant Entomologist on Rs. 215 per monsem	215	
1 Head Clerk on Rs. 150 per monsem	150	
1 Second Clerk on Rs. 59 plus special pay at Rs. 10 per monsem	68	
1 Third Clerk on Rs. 42 per monsem	42	
1 Biometrical Assistant on Rs. 90 per monsem	90	
1 Compiling Assistant on Rs. 69 per monsem	69	
1 Compiling Assistant on Rs. 54 per monsem	54	
1 Draftsman on Rs. 47 per monsem	47	
1 Fieldman on Rs. 34 per monsem	34	
1 Lorry allowance to a Fieldman at Rs. 20	20	
1 Fieldman on Rs. 31 per monsem	31	
1 Peon at Rs. 18 per monsem	18	
2 Peons at Rs. 17 per monsem each	34	
		<hr/>
		872 × 12 = 10,464

II.—Allowances, Honoraria, etc.

1. House Rent and Other Allowances—		
(a) to Officer (L. R. E. Karachi) at 60 per monsem	720	
(b) To Establishment	1,500	
2. Travelling Allowance—		
(a) Officer (L. R. E. Karachi)	3,500	
(b) Establishment	1,000	

III.—Contingencies, Supplies and Services.

Contingencies, etc.	3,000
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IV.—Grants-in-aid, etc.

Leave and Pension contributions—	
(a) Officer	2,850
(b) Establishment	326

GRAND TOTAL FOR A—HEADQUARTERS	35,360
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B.—SURVEY PARTY.

I.—Pay.

	Rs.
Pay of Establishment—	
1 Locust Research Assistant on Rs. 225 per monsom (at Barmor)	225
1 Fieldman on Rs. 34 per monsem	34
4 Field men on Rs. 33 per monsem	132
2 Fieldmen on Rs. 32 per monsem	64
6 Messengers on Rs. 12 per monsom	72
1 Peon (at Barmor) on Rs. 16 per monsom	16
*1 Fieldman (for Khairpur State) on Rs. 30 per monsom	30
*1 Messenger on Rs. 12 per monsom (for Khairpur State)	12
	<hr/>
	585 × 12 = 7,020

II.—Allowances, Honoraria, etc.

Travelling Allowance of Establishment	4,500
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III.—Contingencies, etc.

Contingencies, Supplies and Services	3,000
Grand Total for B—Survey Party	<hr/> 14,520 <hr/>

C.—PASNI, ETC.

I.—Pay.

Pay of Establishment—

Pasni—

1 Assistant Entomologist at Pasni on Rs. 275 per monsom	275
1 Locust Research Assistant on Rs. 155 per monsom	155
1 Locust Research Assistant on Rs. 135 per monsom	135
1 Clerk on Rs. 54 per monsom	54
5 Fieldmen on Rs. 41 per monsom	205
2 Local Fieldmen on Rs. 22 per monsem each	44
2 Messengers on Rs. 12 per monsem each	24
3 Peons on Rs. 18 per monsom each	54
1 Water-Carrier on Rs. 12 per monsom	12
*1 Messenger on Rs. 12 per monsom	12
	<hr/>
	970

*These are additional posts.

Ambagh—

	Rs.
1 Locust Research Assistant on Rs. 145 per monsem ..	145
1 Fieldman on Rs. 42 per monsem	12
1 Fieldman on Rs. 40 per monsem	40
1 Fieldman on Rs. 34 per monsem	34
3 Messengers on Rs. 12 per monsem each	36
1 Peon on Rs. 18 per monsem	18
	<hr/> 315

Mekran Area—

1 Fieldman on Rs. 44 per monsem (at Panygur) ..	44
2 Fieldmen on Rs. 41 per monsem each (at Gwadur and Turbat)	82
3 Messengers on Rs. 12 per monsem each	36
	<hr/> 162
	487 × 12 = 17,364

II.—Allowances, Honoraria, etc.

1. House Rent and Other Allowances to Establishment (Mekran Local Allowance)	1,500
2. Travelling Allowance of Establishment	5,500

III.—Contingencies, etc.

Contingencies, Supplies and Services	4,500
	<hr/> 28,864

SUMMARY.*Main Scheme.*

A.—Headquarters	35,360
B.—Survey Party	14,520
C.—Pasni, etc.	28,864
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Grand Total	78,744

Y. RANCHANDRA RAO,

Dated 27th December 1936.

Locust Research Entomologist, Karachi.

